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The Russian Experience—Obstacles to Foreign Trade.

The experience we are having with Russia may be a good thing if it serves to teach some of us the needed lesson that people who dwell in other parts of the world, who speak a language different from ours, wear clothes differing from ours, have different social customs, etc., may yet be very like us in many ways and above all are not ready to concede that we are the greatest people on earth and that the rest of the world cannot get along without us. We have been too much in the habit of assuming that we can go on indefinitely slapping these people in the face, figuratively speaking, *i. e.*, passing laws and making regulations designedly and avowedly for the purpose of preventing or obstructing trade with them, and have apparently been thinking that they possessed no means of retaliation, or that if they did they would not make use of them. We are very likely to find out our mistake.

The constitution of the United States prohibits the levying of an import duty on goods coming into one State of the Union from another State, and so we have here the greatest area of land and the greatest variety of climate and mineral and agricultural productive capacity ever enjoyed by any people without restriction of interchange. We can therefore get along better without foreign trade than can any other nation of the world. If we think it is best to do so we can declare that we do not wish any foreign trade whatever and may throw every possible obstacle in the way of such trade; but it is becoming more and more plainly evident every day that we cannot so declare and so act and at the same time induce the people of other nations to keep on buying of us and refrain from themselves putting any obstacles in the way of their own foreign trade with us. It is true that a large share of Europe must continue to be fed by our agricultural products or suffer for the lack of them; but it is equally certain that they will find a way to get along without our machinery and other manufactured products unless we show a recognition of the fact that they also are human beings with the right to live and the right to seek foreign markets for what they produce. We do not pretend to say what would be the best policy. That is for the people of these United States in their wisdom to decide, but we do insist that it is as plain as day that one policy or the other must be adopted and that we must be at least reasonably consistent in whichever policy we choose to follow. This talk of "developing foreign markets," while we refuse to concede the right of the people of other countries to do the same, is childish and will not do as a commercial policy.

And so far as the tariff upon machine tools is concerned, we know that very few of those American machine-tool builders who have been abroad and studied conditions there think that it serves any other purpose whatever than to help foreign tool builders in their efforts to secure a higher tariff for their protection against American tools. In Germany especially this is notably true, and has been generally recognized by American tool builders regardless of political affiliations or of sentiments regarding the protective tariff principle as a whole. Very few American tool builders have any fear of foreign competition here, and most of them recognize that their foreign business depends upon their being able to produce machine tools more cheaply than their foreign competitors, quality for quality. The business already done abroad has depended largely upon that fact and all hope of future business abroad also depends upon it.

It is "a condition, not a theory, that confronts us" and the facts must be not only recognized but boldly faced. American tool builders can, if they choose or think best, stay at home and do no business abroad; but if they do wish to do business abroad and to develop that business they must recognize existing conditions as they are. And it must be clear to him who will look squarely at the facts of to-day that the conditions of our foreign trade are essentially different from what they were a few years ago. Rightly or wrongly our manufacturers were formerly interested only in maintaining their hold on our own markets. Few of them expected to do business abroad, and as a matter of history, many of them were slow to believe that they could manufacture machinery here that could be sold abroad. Nothing but actual orders from responsible dealers abroad served to convince many of them that it could be done. Naturally, under the circumstances, most of them believed they needed a tariff to protect their own home markets. But now the shoe is on the other foot, so to speak. Stimulated no doubt in part by the tariff policy our works have multiplied until they have outgrown our own needs and a competition between them has grown up that is in many lines extremely severe—far more so, we believe, than is to be found anywhere in Europe in the same lines. Our manufacturers are interested as exporters of these lines of machinery and most of them see clearly enough that the present effect of the tariff upon machine tools is to assist their foreign competitors in building up tariff walls against us and to enhance the cost of materials which enter into machine construction, here especially when the production of these materials is controlled by trusts or other organizations that are able to prevent home competition.

We know that by thus plainly speaking we invite the wrath of those who refuse to look at these matters except through the spectacles made and bearing the trade-mark of their party, but this is becoming less and less a political question in the ordinary but perverted meaning of that term and more and more a business question; it is a duty to give it the attention its importance demands.

The Berliner Telephone Patent.

A decision has been rendered by the United States Circuit Court in Boston that the Berliner patent for the transmitter used by the Bell Telephone Company is invalid. The application for this patent was made nearly twenty-four years ago, but owing to the legal entanglements to which it has been subjected is still alive, apart from the recent decision, and may

run till 1908. An appeal to the Supreme Court will keep it alive till 1904 at least.

This patent was at one time attacked by the United States itself, with charges discreditable to the Patent Office, but the suit was unsuccessful. The present case goes to the merits. The court in Boston holds that Berliner had not made his invention at the time he applied for his patent; that the invention as described in the patent differed radically from that described in the application; that the invention had already been patented by Berliner in 1880 and, finally, that Edison was the prior inventor.

The improbability that the Bell Telephone Company will be materially affected by the late decision is shown by the fact that the resulting break in its stock—"American Telephone and Telegraph," as it is now designated—was comparatively small and quotations have since recovered in part. It is charged, indeed, that the company holds both sides of the case. The legal tactics which have successfully been pursued to keep this patent alive show the way that it is possible to give a patent a much longer life than the seventeen years nominally allowed by law. Closely related to this subject are some of the observations of the Commissioner of Patents in his report for the year 1900, which is printed in another column of this paper.

The "Prevailing-Rate-of-Wages Law" Overthrown.

The spirit of governmental paternalism received a knock-out blow last week from the New York Court of Appeals. That spirit was at the time manifested in one of its favorite guises, which is the attempt of authorities having legislative power over public improvements to control the details of matters which do not proximately concern them. The court by a vote of 5 to 2 declared an act of the State legislature known as the "Prevailing-rate-of-wages Law" to be unconstitutional. This law had been passed in 1897, and provided that a contractor performing public work should pay his workmen at a rate which "shall not be less than the prevailing rate for a day's work in the same trade or occupation in the locality." If the contractor failed to comply the municipal authorities were required to withhold moneys due him. William J. Rogers, a contractor, sued the Comptroller of New York City to recover $2,863 thus withheld, and in this case the decision was rendered.

The opinion was based in part on the ground that the law, if sustained, would permit and require the expenditure of the money of a city or the local property owner for other than public purposes, for it would add to the cost of improvements. But particularly is it maintained that the law was inconsistent with the principles of civil liberty. It attempted to deprive contractors of the power to make with their workmen such wage agreements as they chose, and set up instead an arbitrary and uniform standard, vaguely expressed, difficult to ascertain and subject to constant change from artificial causes. If the Legislature can do this, why, argues the court, has it not the same power with respect to all private persons and all private corporations? But this is impliedly prohibited by the fundamental law. Judge O'Brien, who wrote the prevailing opinion, contended, moreover, that the act of 1897 would operate against unskilful workmen or else give them the same pay that skilful workmen get and compel the taxpayers to foot the bills.

The late decision is pronounced one of the most important the Court of Appeals has ever rendered. Its effects are believed to be far-reaching and may immediately involve many millions of dollars. Among the public improvements in New York city to which it would apply is the rapid transit subway, the contract for which was entered into with the enforcement of the law in view. The construction of the East River Bridge will also be affected.

Similar in principle to the act just declared null is the Cut Stone law, which requires the exclusive use on public buildings of stone cut in the city, and this law will probably fall with the other.

Foreign Trade Notes.

The Servian Government has just granted a concession to Messrs. R. Godjevatz Frères, of Belgrade, for the erection of machine shops and foundries. The firm will especially engage in the manufacture of agricultural machines and implements, tools and machine parts. All the machinery, tools and material required for the construction, equipment and working of the new plant will be admitted duty free. It is understood that some $50,000 will be spent for the purchase of machinery, tools, etc. Servia possesses no iron industry of its own, and up to the present time the great bulk of iron, steel and manufactures thereof has been imported from Germany and Austria-Hungary. These two countries practically control the iron trade of the Balkan States. In 1899 the imports of metals and goods thereof into Servia amounted in value to about $1,360,000. This includes iron, steel, hardware, machinery, etc. The imports of machinery proper were valued at about $282,000, of which, with the possible exception of some agricultural machines, nothing came from the United States.

The Compagnie des Chemins de fer de l'Est (Eastern Railway Company) has purchased land adjoining its holdings at Epernay, France, and is building, or about to build, new shops. The old boiler shop was especially inadequate to meet the company's needs.

The English Vice-Consul at Monterey, Mex., pronounces the place an important industrial and mining center, but badly off for mining and general machinery. It is proposed that a number of English firms unite and establish a central depot provided with all necessary machinery for mines, foundries, shops and agriculture. The English seem to be ahead of the Americans in that method of doing business, as exemplified in the Argentine.

Consul Hill has sent from Amsterdam, Holland, plans for electric works in that city, including a power plant, dynamos, etc., for the central station. They have been filed in the Bureau of Foreign Commerce for reference by prospective bidders.

A new tariff for British Honduras went into effect February 1, and provides that revolvers shall be subject to a duty of $3 each and rifles $1.75, all other merchandise unenumerated 10 per cent. ad valorem. The following are some of the items that appear on the free list: Agricutural implements, such as cane bills, cane knives, cornshellers, harrows and hoes, ploughs, Demarara shovels; fencing wire and staples; iron framework and girders for buildings and iron bridges; machinery, agricultural, marine and manufacturing and parts thereof, including boilers, belting, and steam pipes; pans for boiling chicle and sugar; materials for railways, tramways, electric lighting, telegraphs or telephones; pumps, tanks, iron, trucks, vats, vessels and boats.

An electric tramway has been talked of at Aukland, New Zealand, for three years and more. Several contracts have been granted to local firms and to London syndicates, but the change has not been made. A New York company has now arranged to build the road. Rails, cars and other material will be brought from America, as well as a force of men to equip and put it into operation. The cost of the line will be about $1,000,000.

The poignancy of chagrin which American machinery builders feel at the blow lately dealt to trade with Russia must be given a still keener edge by transmission to the State Department of such documents as the following translation from the "Deutsche Export Zeitung," which was sent in by Consul Winter from Annaberg under date, January 22:

"The increase in the trade of the United States with Russia is noticeable. This is due to the cordial relations which exist between these two countries and to the less friendly attitude of Russian merchants toward the manufacturers of other countries. The greater part of the orders for the Siberian Railway has been placed in the United States. Another large order, amounting to $595,000 in value, has just been placed in America for machinery to cut tunnel of about 1½ miles in length not far from Charbin, in Manchuria. The tunnel is to be finished in one year's time. Direct connections will then be completed

between Europe and Vladivostock. The United States has outdistanced Germany in the markets of Russia."

The loss of Russian trade to the tool builders is a more serious matter than is perhaps generally realized, because, as we have previously stated, the total value of American tools finding their way to that country was greater than statistics showed, since many of them had been re-exported from Germany, having been sold by German houses acting as the selling agents of American manufacturers.

Commercial Review.

NEW YORK, Monday, March 4.

MACHINE TOOLS AND OTHER MACHINERY.

The weight of testimony among machine-tools sellers in this city is that February developed a better trade than January. Even without allowing for the shortness of the month and for the holidays, one representative dealer estimated his trade as showing an increase of 10 per cent. Another authority notes a gratifying number of new enterprises. With the suitable expansion of business that has taken place in the second month of the year it may be pronounced quite satisfactory, so far as the domestic market goes.

Some of the Rock Island contracts have been let. One firm in this city has received $30,000 or $40,000 of them and another, according to report, $75,000; but so far as we have been able to learn the orders given out were for special machinery, where the recommendation was in favor of the lowest bidder and there was little or no competition. The bones of contention including the big lot of milling machines were to last accounts still under dispute. One of the local magnates of the tool trade was stated to be in Washington in reference to the business Friday last.

The British Westinghouse contracts are still pending and are likely to be for three weeks yet. It is anticipated that the contracts will be made out in England and sent over to this country—that is, of course, so far as they come to this country. There has been a sharp English competition to secure them. One man says he knows of half a dozen foreign representatives who have come over for this purpose. The amount of money that has been spent in the pursuit of those contracts altogether is enormous, and it is seriously to be questioned whether any profits that may accrue when they are awarded will not prove to be swallowed up by railroad and steamship fares and Pittsburgh hotel bills.

A plant which in magnitude is comparable to the British Westinghouse Company and which will probably be one of the engineering wonders of this country is the new one to be built by the E. P. Allis Company. Local tool men have hardly yet given it consideration.

The Garvin Machine Company cleared out by auction sale last week a large quantity of old machinery, etc.

The Brown & Sharpe Company is said to be very busy at present.

The office and stock of the Pratt & Whitney Company in this city have been moved across to No. 138 Liberty street, the quarters of the Niles-Bement-Pond Company. This is but a return home on the part of the Pratt & Whitney Company office, for it shared a part of the same showroom with the Niles Tool Works before it took the store just vacated.

A well-posted authority on American tool trade with Germany, in this city, when questioned, gave his opinion that while the recent tariff action on the part of Russia may prove some encouragement to Germany to increase her duties against us there is little probability that these will be made prohibitive. Even were they doubled, he says, it would be relatively a small matter.

Proposals will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until noon, March 26, to furnish at the navy yard, Mare Island, Cal., a quantity of machine tools, air compressors, boilers and pumps. Blank proposals will be furnished by the bureau or the navy pay office, San Francisco, Cal.

The Rogers Locomotive Works, Paterson, N. J., have been appraised by a New York machine-tool dealer. There are five prospective bidders for the works.

The Chambersburg (Pa.) Engineering Company has awarded a contract for the erection of a steel shop to be 60x58 feet. The shop is to be completed in two months. In the shop are to be installed a 50-ton traveling crane and a 12-foot planer.

The late contract for two new battleships, taken by the Fore River Engine Company, necessitated the incorporation of this firm, which has recently been carried out in New Jersey under the name Fore River Ship and Engine Company, with $4,000,000 authorized capital. We have already printed a notice of the incorporation which is thus explained. Thomas A. Watson, president of the old concern, has formally conveyed to the new one property at Weymouth, Fore River and Bent's Creek, estimated to represent a price of $1,000,000. This includes the new site at Quincy Point, Mass., with buildings, etc. The old site at East Braintree is being abandoned.

PITTSBURGH REPORT.

The iron and steel market has been showing a decided bracing up the last week or so, with steadily advancing prices for raw material. The finished lines also appear about to strengthen, which serves to show the fact that business is good and the prospects bright. During the past week there has not been a check in the pig-iron advancement and consumers are asking for prompt or spot shipment. Sales have been large, the largest buyer during the week being the Sharon Steel Hoop Company, which made a big purchase of new steel and also of scrap steel at the market quotation.

The billet market is stronger with prices anywhere from $1 to $2 a ton higher than a week earlier than the time of writing. In finished lines, there has not been any announcement made of a higher figure, but it is almost certain that bars, plates and sheets will go higher in a short time. Structural material will also be better in price. Mills in this vicinity have work for the next sixty days and any offers for material within that time are declined. No large contracts for structural, especially for long-time delivery, are turned aside, but the ordinary run of business is not attractive. Every line of steel production is oversold for the coming sixty days, and it is more than likely that prices will climb upward in most of these lines.

Foundry iron is doing well, especially as regards prices. No. 1 Northern is selling at $15, No. 2 at $14.25 and $14.50 and No. 3 at $13.75. The furnace capacity throughout the entire Pittsburgh and valley districts is increasing, the stacks all being in active operation, while the new month will see one of the big Ohio plants go in blast with a daily capacity of 1,800 tons.

The Pittsburgh (Pa.) Valve, Foundry and Construction Company, a combination of local foundry and iron-casting concerns organized last year, has closed a deal with the American Steel Casting Co. for its extensive plant at Twenty-sixth street and the Allegheny Valley Railroad, which the American company is vacating while enlarging at Sharon. The Pittsburgh company buys the buildings, sidings, engines, dynamos, boilers and general equipment. The new foundry, the purchasers claim, will be the largest in Pittsburgh. It will have a capacity of from 40 to 60 tons daily. The company's present capacity in the iron-casting department is about 15 tons daily. It is not the intention to go into the manufacture of steel castings, but to enlarge the capacity for iron castings. It is the intention of the new owners to be operating at the newly acquired plant by April 1. Aside from the A. Spear & Sons plant on Duquesne way and Fifth street, the foundry combine owns the old Atwood and McCaffrey works on Third avenue, the plant of the Pittsburgh Valve and Machine Company at Twenty-seventh street, the old Shook-Anderson plant at First and Ferry streets and the pipe-fitting department of the Wilson-Snyder Manufacturing Company. All these will eventually be transferred to the new location. H. M. Atwood is president of the Pittsburgh Valve, Foundry and Construction Company, J. T. Spear is vice-president and C. A. Anderson is treasurer.

At the new thirteen-story union station of the Pennsylvania Railroad, at Pittsburgh, there will be built a power house 47x312 feet. It will be used to furnish about 15,000 lights to light the station, yards, shops and signals as far out as East Liberty; steam to heat the station and the passenger coaches in the train-shed at night; compressed air for the electro-pneumatic switches in the Pittsburgh yards, and other purposes. The equipment will include eight Babcock & Wilcox boilers, aggregating 2,500 horse-power, with Roney mechanical stoker and Hunt conveyor outfits; four 350-kilowatt Westinghouse generators direct-connected to Westinghouse engines; a motor-driven and an engine-driven exciter; two Riedler air compressors, each 20 feet high, with a capacity of 1,500 cubic feet per minute, and one large single-acting Riedler hydraulic pump for running the twelve elevators in the station, seven of which will be used for passengers.

CHICAGO MACHINERY MARKET.

Some statistics of the Chicago Edison Company show the growth of electricity as an element of power transmission in this city. That company is now furnishing 17,022 horse-power for power purposes. Of this about 7,000 horse-power is consumed in elevator service and the remaining 10,000 horse-power for general "power" purposes, almost exclusively manufacturing. The increase from a year ago is 3,542 horse-power, or more than 20 per cent. In addition to this, the Commonwealth Electric Company, controlled by the Chicago Edison, furnishes about 3,000 horse-power for "power" purposes. The main market of both companies is of course electric lighting. One large building of the company, designed for small users of power, was only two-thirds filled with tenants two years ago when electricity was installed; now there is a waiting list of prospective tenants. A 20 per cent. increase in the use of electricity by small manufacturers within a year may perhaps be regarded as a good healthy gain, but there is not at present an avalanche of inquiries from prospective builders of manufacturing structures, not so much because there is no demand for electricity as because the number of inquiries for small power facilities is not now much in excess of present accommodations, and landlords are slow to inaugurate changes.

From individual users of electrical power, market conditions for the future are flattering. There is a very large amount of business in sight for early closing. Makers of electrical machinery generally report activity, and the prospective inquiry comes from all branches of trade.

The American Car and Foundry Company has purchased for its new plant to be erected at Detroit, Mich., a complete electrical equipment, consisting of three 250-kilowatt generators, etc., from Westinghouse, Church, Kerr & Co. Early delivery is asked, as the building is to be pushed to rapid completion.

The Pullman Palace Car Company has just bought from the Central Electric Company two Bullock 150 horse-power generators for lighting and power purposes. This is an addition to present equipment. The Central Electric Company reports prospects for the best year's business in its history.

W. S. Tyler & Co., Cleveland, Ohio, have purchased from the Crocker-Wheeler Company a 450 horse-power direct-connected generator.

The Cleveland Construction Company has taken the contract to construct the Aurora, Wheaton & Chicago Electric Street Railway.

CINCINNATI REPORT.

One distinctive feature of the market in this section is that among the larger and more representative manufacturers of milling machines, wood-working machinery and large tools the demand shows a steady increase. A representative of a big tool concern established here twenty-seven years says there is not a dissenting voice to the statement that representative concerns are eminently satisfied with present conditions. This same gentleman, referring to the character of inquiry, so far as he has opportunity to judge it, notes that multiple drills and the heavier types of tools have the call. A representative order was for the B. & O. shops at Baltimore, Md., where three large multiple drills had just been shipped.

Of the thirty odd manufacturers of machine tools and allied lines in this vicinity, it may be said that as many as a dozen are now feeling the effects that always mark the records of those hastily conceived and overproductive concerns; otherwise, the situation is eminently satisfactory.

As to the probable effect of the United States Steel Corporation upon smaller independent concerns, the words of a prominent independent manufacturer at Wheeling, W. Va., are interesting. Says he: "The steel combine will not injure the smaller concerns, but will rather help them. The consummation of such a deal involves such a large capital that they would, of course, have to make much larger profits proportionately than the other concerns in order to satisfy their stockholders." As to the prospective consequence, this manufacturer says "there are indications that the price of steel will go up soon after the combine is completed."

Activity among the Ohio manufacturing cities, particularly in the steel and iron plant line, is noticeable at this time. The McCullough Brothers, of Zanesville, are contemplating building a plant which will be capable of turning out 200 tons of skelp and 50 tons of sheet per day for the tube works. A chain mill is another interesting adjunct to the Zanesville manufacturing colony. The Ohio Iron Works at Zanesville will double its present capacity and manufacture 100 tons of skelp for the tube mill. From Springfield comes the news of the American Engineering Company's purchase of the old Armstrong Boiler Works. They will manufacture feed grinders and gas engines, and expect to begin operation in about two weeks.

A Chattanooga (Tenn.) firm has just received a contract for the manufacture of 200 cast-iron artillery gun-carriages for the Shiloh Battlefield Park.

In relation to the steel syndicate deal, a statement is made coming from Canal Dover, Ohio, that ten of the steel mills in Ohio and Eastern Pennsylvania, owned by the syndicate, are to be centralized at that point. If this plan prevails, the Cambridge (Ohio) mill, that at Miles (Ohio) and some Newcastle (Pa.) interests will be dismantled.

Mr. Francis E. Rainey, of London, England, importer of American machinery, a visitor at the Business Men's Club last week, spent a couple of days among the Cincinnati manufacturers and made several deals which will mean considerable to these concerns in a foreign way. His visit teaches that iron, brass and copper fittings, pipe and tubes and steel chain have value for export to England. Mr. Rainey is an avowed disbeliever in trusts.

Quotations.

NEW YORK, Monday, March 4.

Pennsylvania Foundry Pig Irons, Jersey City Delivery:

No. 1 X	$15 65 @ $16 50
No. 2 X	15 25 @ 15 50
No. 2 plain	14 50 @ 15 00
Gray forge	13 50 @ 14 65

Alabama Pig, New York Delivery:

No. 1 foundry, or soft	15 50 @ 16 00
No. 2 foundry, or soft	15 00 @ 15 50
No. 3 foundry	14 25 @ 14 50
Foundry forge, or No. 4	13 50 @ 14 00

Bar Iron—Base sizes—Refined brands, mill prices on dock, 1.50 @ 1.60c.; from store, 1.75 @ 1.80c.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. upward.

Machinery Steel—Base sizes—From store, 1¾ @ 2c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½ @ 2¾c.

Copper—Lake Superior ingot, 17c.; electrolytic, 16⅝c.; casting, 16½ @ 16⅝c.

Pig Tin—26½ @ 26⅝c., for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½c. extra for carloads.

Spelter—3.97½ @ 4.00c., New York.

Antimony—For 5-cask quantities Cookson's is about 10½c.; Hallett's, 9c.; Italian, Hungarian and Japanese, 8¾c.

Lard Oil—Prime City, from 1 barrel up, 65 @ 66c., according to quantity.

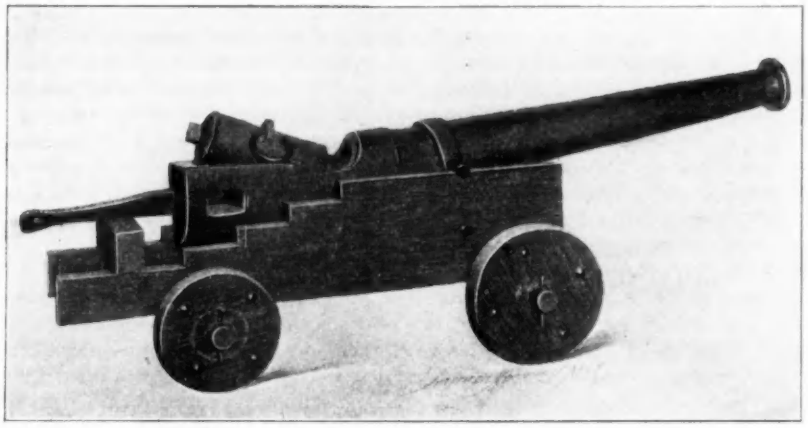


FIG. 1. CHINESE BREECH-LOADING CANNON ON IMPROVISED MOUNT—BROOKS COLLECTION.

Rapid Fire Guns, Ancient and Modern.

BY E. G. PARKHURST.

Since the advent of rapid-fire guns (cannon) the question has been repeatedly asked, what is a rapid-fire gun and how does it differ from the ordinary cannon? The word "rapid" has no significance other than its literal meaning—*i. e.*, having great speed, moving or acting quickly. R. F. are abbreviations of rapid and fire and may be applied to any gun whose system admits of being operated with rapidity. All rapid-fire guns receive their charge at the breech instead of the muzzle, as was the general practice for a hundred years or more. Breech loading in itself is no new invention. It may not be known to all, though nevertheless the fact that from the very beginning such methods of loading ordnance were devised and put in practice by the Chinese as early as the year 1312, if not earlier.

CHINESE BREECH-LOADING GUNS.

There is one specimen of Chinese workmanship in the museum of the United States Army Artillery School. It is a bronze gun and was captured from the Coreans by Rear Admiral John Rogers, U. S. N., June 11, 1871. In this gun the charge was contained in a hollow breech with a handle at the top by which it was placed in position. This breech block had projections on the lower parts of rear end, and these with the assistance of a key driven above them, through mortices in the side of breech, held the block in place for firing.

Another Chinese gun, shown in Fig. 1, is in the Brooks collection at Hartford, Conn., and, unlike the one just described, is of forged wrought iron. It bears Chinese cabalistics which fix the date of its construction at about 1373. This cannon was sent to the United States by the princes of East India with their exhibit for the World's Fair at Chicago in 1893. The statement concerning what is known of the cannon was duly authenticated by credentials from the English house in Bombay, India, which invoiced the collection.

The general form and principles of the breech block and closure are the same as in the Corean gun, though differing in the material from which it is made and in having the bore cored out at the breech. The extreme length over all is 5 feet 8 inches. The bore of tube is 2 inches and its length 3 feet 6 inches from face of breech to muzzle, which is 5 inches in diameter at the swell. The chase is 3¾ inches in diameter in front and 5 inches at the rear. Beginning 3 inches from the front of breech face is a body 6¼ inches across the top, enlarged to 8 inches at the rear, from which extends backward a handle or tail-piece, terminating with a knob. The before-mentioned body is hollowed out in the form of a trough, having an aperture about 12 inches in length to receive the breech block. The sides of the trough are about 1¾ inches thick, commencing at breech face above the line of bore and taper upward to the rear, leaving about 2 inches of metal above the upper sides of the mortices, which are about 3x2 inches and are intended to receive the wedge key which abuts against and resists the rear thrust of the breech block.

The hollow breech block is about 4 inches in diameter, is bored from the front end with a hole 2 inches diameter and 8 inches deep and is provided with a vent hole. It has a projection in front out-

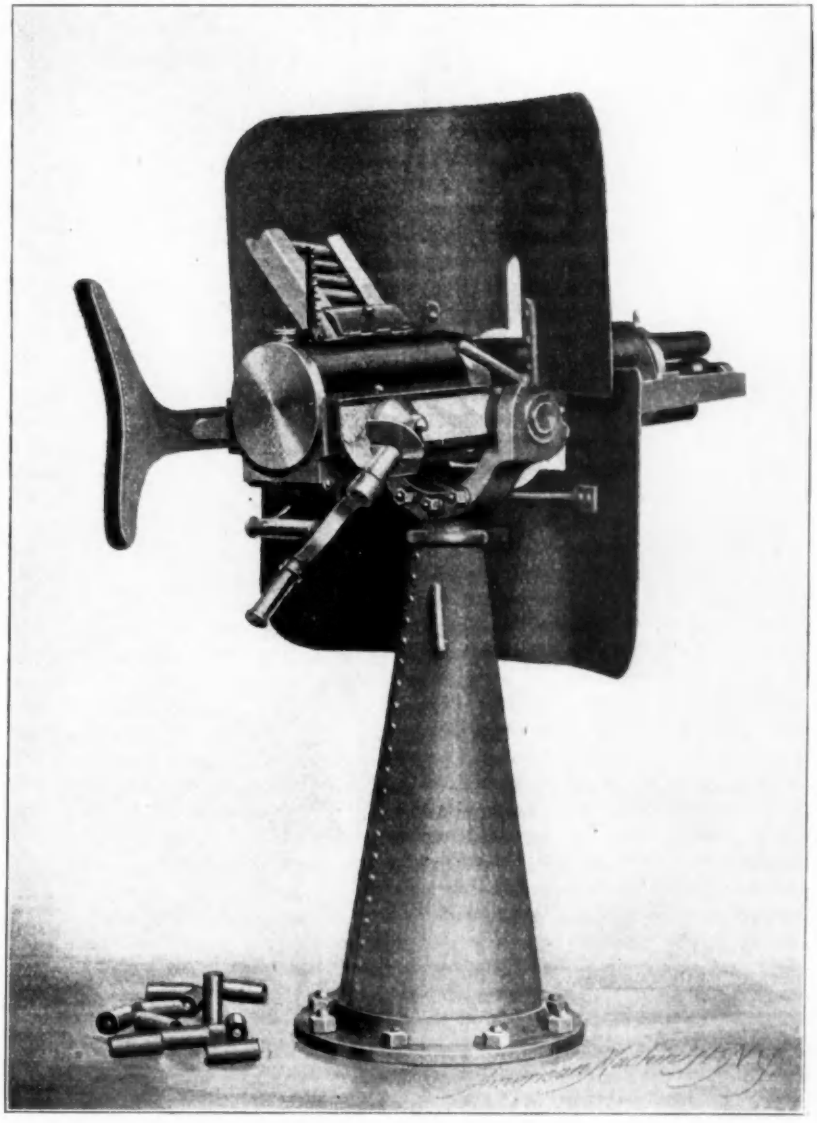


FIG. 2. HOTCHKISS 37 M/M REVOLVING CANNON ON CONE STAND WITH SHIELD.

side coned to fit the before-mentioned coned recess at breech of tube. At the rear is a projection to pass under the wedge key. Thus the entering of the tapered block into the tube not only centers it in line of the base, but also prevents it from lifting. The rear of the block rests on lugs, which guide and center it and the wedge key passing over the projection, at the same time forcing the block forward, provides a very secure breech closure.

A trunnion band 2 inches wide by ¾ inch thick, with trunnions 1½ inches diameter, is welded to the tube in such a position as to give a preponderance to the breech. There is an oblong aperture extending downward through the body directly under the joint of block and tube, supposed to be a gas escape. The weight of gun is about 325 pounds.

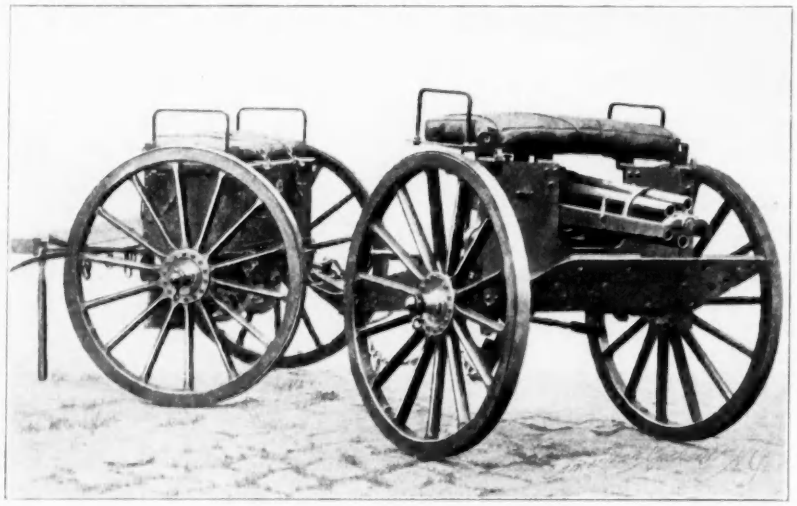


FIG. 3. HOTCHKISS 37 M/M REVOLVING CANNON WITH FIELD EQUIPMENT, FOLDING SHIELD.

Taking the gun as a whole, it is an exceedingly fine specimen of handicraft. Even in our day with modern heating and forging appliances, it would be a troublesome affair to duplicate such a forging.

It requires a small stretch of the imagination to call the system one of rapid fire, as compared with muzzle loading. As there could have been no limit to the number of loaded breech blocks, with a crew of trained operators, the putting in, firing and taking out of the blocks would have required a small amount of time.

SPANISH GUNS.

The cunning old Spanish artists came a little nearer, in principle, to the modern breech loader. There are two specimens of Spanish breech-loading guns in the Military Museum at Washington, D. C., taken from Mexico, and said to have been brought over from Spain by Fernando Cortez at the time he forced Mexico to acknowledge the supremacy of Spain.

Having no exact data at hand, I give the description from memory. The guns are of bronze, about 3 feet in length, with trunnions and slight muzzle rings, and had cascabels. The bore, about 2½ inches, terminates in a mortice, or pocket, 7 or 8 inches long, near the breech, into which is inserted the breech closure, a piece of iron in the form of a tailor's pressing goose, except that it has square ends for abutting the powder charge at the front, and the pocket in the gun at the rear.

There are in the Military Museum at Woolwich, England, five Spanish breech-loading guns, all of forged wrought iron, and said to have come on shore from wrecked vessels of the Spanish Armada, in 1587. Curiously enough, one of them is composed of staves, wound with a rod of iron; very suggestive of being wound with wire, had there been such material in those days.

It may be asked by some inquirers, What have the old breech-loaders to do with modern quick-firing guns? We answer, to show the underlying strata of invention. There are really no new systems of breech closures, either of the plug or the screw type, which latter was invented somewhere between 1404 and 1419. The drop block appeared some time during the seventeenth century. We also wish to show that the old artists began their business at the right end, though compelled, from cause, to abandon their inventions. They could not control the powder gas at the breech. Gunpowder—nitre, sulphur and charcoal—was in powdered form, and was mixed then and there, on the field or on shipboard. Powder was not corned for hundreds of years after its first discovery. The gas check and metallic cartridge case, with its percussion primer, had not come. All these advances in science made it possible to utilize the germs of old inventions of breech closure which are now in use for the modern rapid-firing guns, of which there are many notable systems, of quick action and reliability.

THE FIRST REALLY RAPID-FIRE CANNON.

Mr. B. B. Hotchkiss, a born inventor, was one of the most gifted and remarkable men of his day in matters relating to ordnance. In his younger days he had an aptness for experimenting with explosives and projectiles. Although he had not the advantage of technical training, his Yankee ingenuity, coupled with shrewd common sense, enabled him to reduce theory to practice, and his name will be ever remembered as a chief among military savants and a prince among men. Mr. Hotchkiss brought out steel field guns in 1860. A battery of such guns was presented to the United States Service in 1891. Early in the sixties he went to Austria, and at Vienna commenced the manufacture of ammunition for small arms. In 1871 he first conceived the idea of a revolving cannon, which would be able to produce a continuous hail of cast-iron explosive shells at very long ranges, and which should have little or no recoil to interfere with continual operation of the gun or the accuracy of its fire. The first gun was brought out that year. In 1872 further experiments were made, but

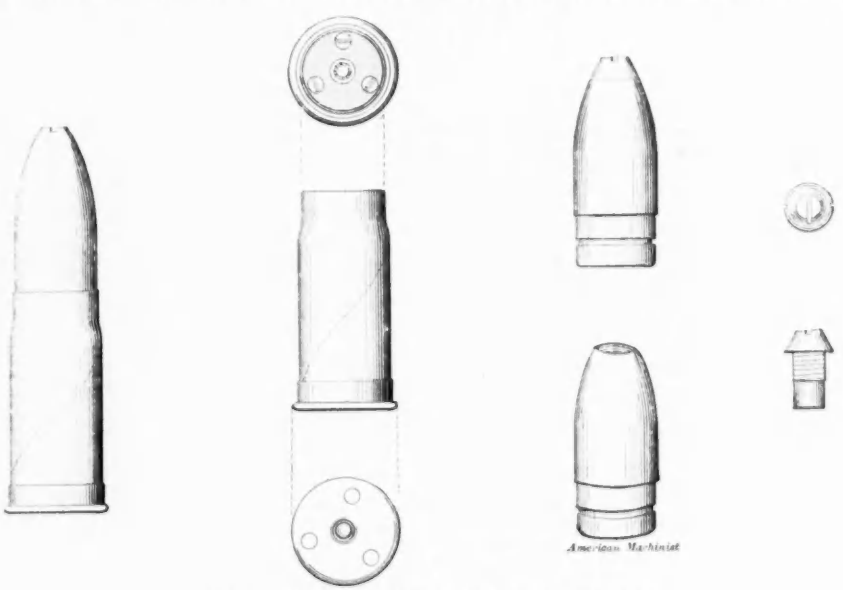


FIG. 4. AMMUNITION FOR REVOLVING CANNON.

it was not until about the middle of 1873 that the success of the arm was assured, and it was acknowledged by ordnance officers to be the most terrible engine of war, up to that time, invented. The gun was

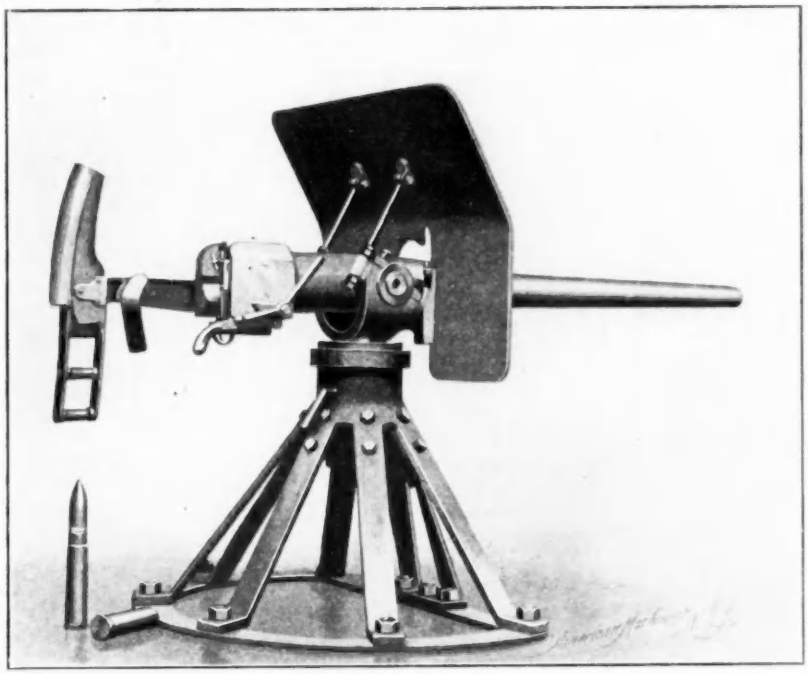


FIG. 5. HOTCHKISS 57 M/M SIX-POUNDER RAPID-FIRE GUN WITH NON-RECOIL MOUNT.

taken to France, and at Paris its manufacture was commenced in a small way.*

THE FRENCH PLANT.

From the small beginning, with a plant operated with twenty men, the business steadily increased, and such was the demand for guns and ammunition that in 1883 about a thousand men were employed at the company's works at Saint Denis, about six miles from Paris. Nearly every European government had them or had orders placed for them. Several had been introduced into the United States Service. In order to show in what repute the arm was held by our ordnance officers, I quote a paragraph from the report of then Col. E. B. Williston, U. S. A., to the Chief of Ordnance, January 1, 1881: "The Hotchkiss revolving cannon has worked to my perfect satisfaction. It is the most accurate and deadly arm of which I have personal knowledge." The Hotchkiss revolving cannon is shown in Figs. 2 and 3.

AMMUNITION FOR REVOLVING CANNON.

The extraordinary success of the gun was largely due to the ammunition. Here again was displayed the genius of Mr. Hotchkiss and his associates in producing cartridge cases, also cast-iron and steel shells, for projectiles. The folded head or solid drawn case had not yet come, except for small calibers, and for the simple reason that there was no demand for it; therefore one of wrapped metal was devised. It consisted of a trapezoidal piece of sheet brass, rolled up in the required shape, the bottom edges being turned in and reinforced to form a base, with a disk of sheet iron riveted on to form the head. This form of ammunition is shown in Fig. 4.

BUSINESS METHODS.

The business methods adopted by Mr. Hotchkiss show his shrewd Yankee common sense and why he succeeded so well in his business both financially and mechanically. As Mr. Hotchkiss once said to the writer: "If you make men interested in a business they accomplish something. I formed a copartnership by giving one-tenth interest to each of my leading men—financial manager, superintendent and artillery engineer. My plan succeeded admirably. My interests are cared for—it is to their interest to do so." On October 15, 1884, a new member was admitted to the firm, Lieut. E. W. Very, who had been an officer in the United States Navy, where he had justly earned the reputation of being skilled in matters relating to construction of naval ordnance, and he to-day, as in the past, stands second to none among artillery engineers. To quote Mr. Hotchkiss' exact words again: "I have the best working team in the world, and for the reason that they all pull together."

ORIGIN OF THE SINGLE-BARREL R. F. GUN, HOTCHKISS SYSTEM.

Early in 1880 Mr. Hotchkiss conceived the idea of making a single barrel do the duty of the many in his revolving cannon. His experiments were commenced early in 1881. How well he, with the assistance of his working team, succeeded may be best told by the thousands now in the service of nearly all nations.

A gun, with non-recoil mount, is shown in Fig. 5. Like all the Hotchkiss guns of that date, it was made of Whitworth fluid compressed steel.

NON-RECOIL MOUNT.

If a gun weighing, say, 800 pounds has a powder charge exploded in it behind a 6-pound projectile with sufficient force to hurl it into space at the rate of 1,800 feet per second, there is generated a tremendous recoil. In a non-recoil mount the trunnions or equivalents receive the whole shock, which is communicated to the yoke pivot and from it to the crinoline-mount stand. The mount shown in Fig. 5 is made up of several parts bolted and riveted together. The socket in which the pivot

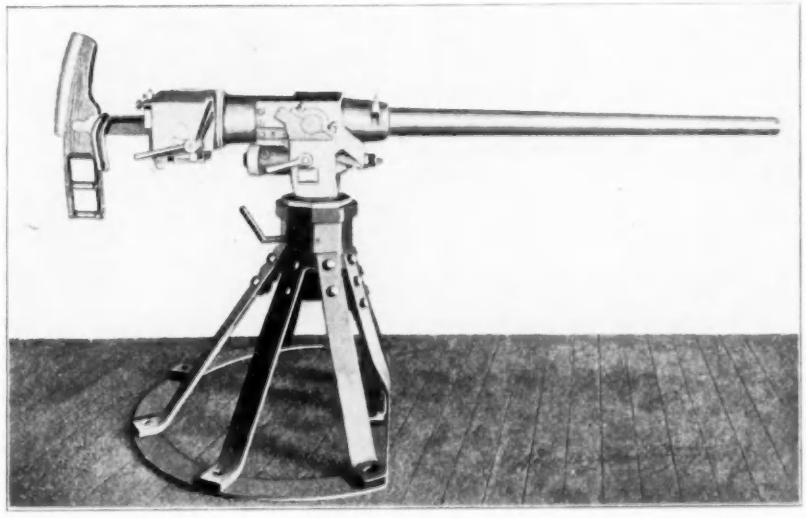
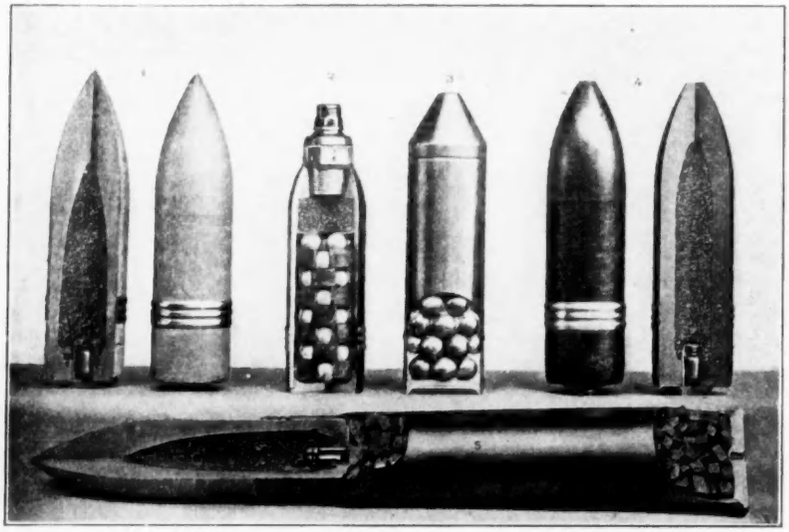


FIG. 6. HOTCHKISS SIX-POUNDER RAPID-FIRE GUN WITH RECOIL MOUNT.

yoke swivels is of bronze, weighing nearly 200 pounds. Inlet, and bolted to it, are eight flat steel braces or legs. All are confined near their upper ends by a band or hoop shrunk over the whole mass. The braces have feet formed at their lower

*The first cannon made by Mr. Hotchkiss, a steel muzzle loader, was taken to Mexico, where it was afterwards captured by French troops and sent to Paris. It can be seen in the French Military Museum.

ends, which are seated on and riveted to the deck ring, of suitable width and thickness, made in the form of about five-eighths of a circle, the remaining three-eighths being straight and at the front. Six of the braces have each a 1½-inch bolt, the front braces have two bolts each. The cage stand is thus secured to the vessel's deck by ten 1½-inch bolts.



1. Steel shell. 2. Shrapnel. 3. Case shot. 4. Common shell. 5. Complete cartridge.

FIG. 7. RAPID-FIRE AMMUNITION IN SECTION.

The yoke which supports the gun by its trunnions is of bronze, the upper portion of pivot being about 5 inches in diameter. The lower end is seated on a suitable step-screw. The service charge, fired in a six-pounder gun, causes the top of cage stand to recoil about one inch. Therefore it may be seen that the non-recoil mount, weighing over 500 pounds, was well named—a "deck ripper." At the present time, all such troubles have been eliminated by the introduction of the recoil mount now in common use in the United States Navy and shown in Fig. 6.

THE RECOIL MOUNT.

The inventor of the hydraulic buffer is said to be one Col. Clark, of the Royal Artillery. The first to adopt the recoil-cylinder system for light guns was Nordenfelt. A little later the Elswic double cylinder appeared, said to have been arranged by Sir. Wm. Armstrong. The first single cylinder put under the gun was arranged by Mr. E. W. Very, formerly a Lieutenant in the United States Navy, now of the Hotchkiss firm. The single cylinder now in general use by the United States Navy is the handiwork of Lieut. F. F. Fletcher, U. S. N., and well the work was done, as it is an exceedingly neat, compact and durable design—the right thing in the right place. The writer was present during the trial of the first one arranged for a 6-pounder gun. It was a splendid success, the actual recoil of the gun being 3¼ inches, with scarcely a perceptable movement of the top of cage stand.

The pivot yoke, of bronze, has journal boxes with caps, secured by cap screws over the trunnions of cradle, which on the inside is hollowed, U-shape, and at the front is built up and across for a recoil abutment. Central with the trunnions on each side are dovetailed grooved ways of suitable length, in which traverse two counterpart slides built on the sleeve, which is screwed over the gun and is kept in position by a short spline secured by a screw drive screw. The sleeve and hydraulic cylinder (cast in one piece) has a head in each end, and lies in the cradle directly under the gun. A piston which fills the cylinder and a piston rod from it passes through the gland in the front head, also through the before-mentioned recoil abutment in cradle, being secured to it by screw, nut and check. Between the piston and front cylinder head is placed a powerful spiral spring, that abuts both. When the gun moves backward under the recoil the cylinder travels with it, compressing the spiral spring. The cylinder is filled with a mixture of water (80 per cent.) and glycerine (20 per cent.), and when the gun recoils, the liquid is obliged to pass from one end of the cylinder to the other, and the flow regulates the recoil. While this movement is taking place, the spring is being compressed, and when the force against it is checked, it expands and returns the gun to its normal position, the recoil being checked by the liquid, and counter recoil produced by the spring. The backward and forward movement of the gun is hardly perceptable to the eye.

Various kinds of ammunition for the guns are shown in Fig. 7.

BEVINS' SEMI-AUTOMATIC ATTACHMENT FOR WEDGE-BLOCK SYSTEM OF BREECH CLOSURE.

One of the most notable inventions lately brought out and perfected is that of utilizing a small part of the tremendous power generated by the recoil of a gun for doing a portion of the hard work heretofore done by the operator. The attachment can be applied to a Hotchkiss three or six-pounder gun having a recoil mount and without the aid of skilled labor. Thus the gun is converted into a semi-automatic gun which opens the breech, thereby extracting the empty cartridge case, and holds stored-up power, which, when released by placing a round of ammunition in loading position, closes the breech block and cocks the firing mechanism.

The real object of the invention is not so much to augment the fire of the gun as to do away with one man of a gun crew, thus saving labor, and eliminating the heaviest work—that of throwing open and closing the breech block.

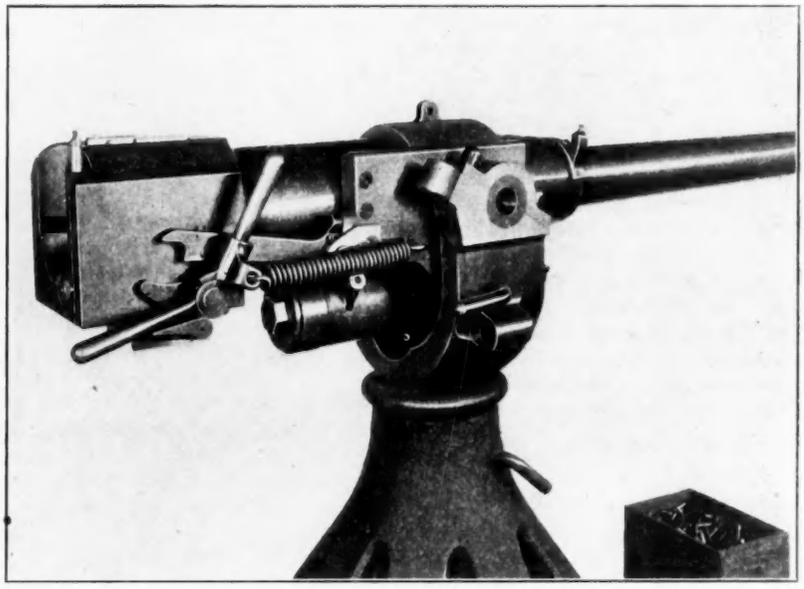


FIG. 8. HOTCHKISS GUN WITH BEVIN'S SEMI-AUTOMATIC ATTACHMENT.

By referring to Fig. 8 it will be seen

that attached (jointed) to the rear end of the trunnioned cradle of mount, which has no lateral movement, are the two prineipal parts of the attachment. First a hinged opening bar, with overlap at its rear end, where it engages a roll fixed on the inside of clevice, which is secured to the upper arm of hand-opening lever. Second, the main spring which is hooked into the eye of the clevice. When the gun recoils, the main spring is stretched and when near the end of the recoil the opening bar drops down behind the roll. When the gun moves forward by the counter recoil the opening bar engages the roll, holds main spring tense, throws down the breech block, which forces back the extractor which is provided with a spring latch, and by it is retained until released by placing a round of ammunition in the loading position. Thus is the breech block closed by the power stored in the main spring. With this semi-automatic attachment, if there be no fire there is no recoil and no opening of the breech block except by hand; therefore ample time is given to judge between a miss or the dreaded "hang fire."

Should the attachment become disarranged or broken, the gun is not disabled as it may still be operated by hand in the usual manner.

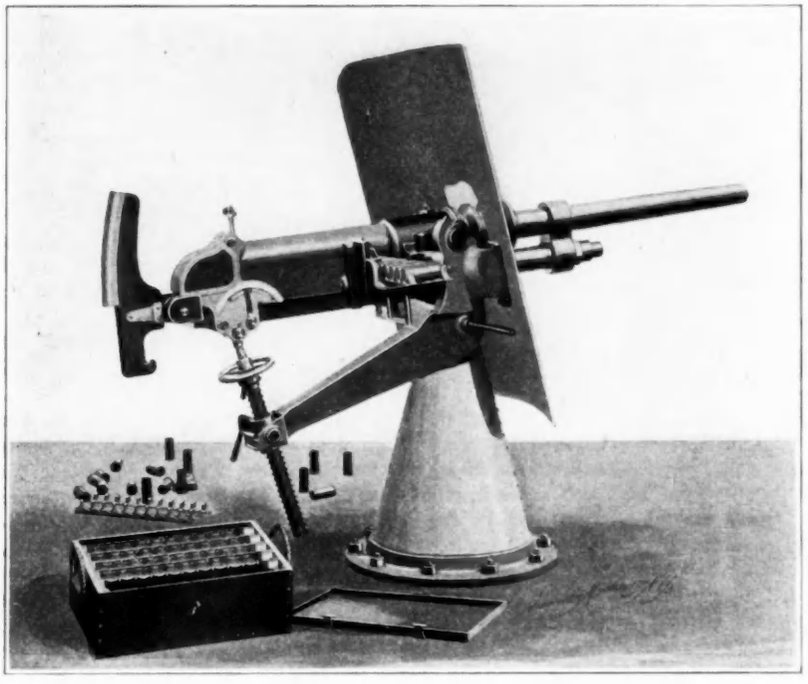


FIG. 9. HOTCHKISS 37 M/M AUTOMATIC MACHINE GUN ON NAVAL MOUNT.

HOTCHKISS AUTOMATIC MACHINE GUN.

During the year 1900 there has been perfected by Mr. Lawrence V. Benet, artillery engineer and director of the Hotchkiss Ordnance Company, of Paris, France, a rapid-fire gun which in its action has fairly eclipsed any heretofore known. It may in truth be said to be one of the most terrible war engines ever invented.

This gun, shown in Fig. 9, is comprised of thirty-three parts; fifteen make up the operating mechanism, containing neither screws nor pins, and including three springs, only one of which is essential to the working of the gun. The entire mechanism can be dismounted or assembled in about one-half minute and without tools. The gun as designed can be operated by a man of ordinary intelligence.

The firing gear is arranged for firing single shots or volleys, at will, and in the latter case the average rate of fire is 200 rounds per minute. The loading is accomplished by means of loading clips, holding ten cartridges. These clips are wholly metallic, and therefore are not affected by oil or water, and they may be indefinitely employed without re-forming. The feed is positive, and, being independent of gravity, is not affected by the elevation or depression of the gun. The action of the mechanism is rectilinear, and the accuracy of fire is not impaired by vibrations of the gun.

The cartridges cannot be introduced into the chamber until the instant of firing, and therefore are not subjected to excessive heat in case the firing be suspended with the gun loaded. The barrel is fitted with a "radiator" over and in front of the chamber, which absorbs a great portion of the heat and dispenses with the use of a water jacket.

An exhibition test of this gun was made in September, 1900, in the city of Mexico, by Capt. Chas. H. Saunders, the well-known expert and agent, for the Hotchkiss Company, of Paris, in the presence of President Diaz and attachés, together with the officials of the Mexican War Department. The official report was that the system operated perfectly. The gun and its designer scored immense success.

It is expected that there will be in the near future an exhibition of this gun at the Sandy Hook proving ground, before a board of United States Army officials.

Echoes from the Oil Country.

ONE KIND OF COURAGE—A PUMP AND A BOILER.

Did you ever meet him, that fellow that isn't afraid of anything? I did and caught a bad cold by it.

You see, that old Cameron pump was one of the "old residenters," as the boys say. It must have given trouble years ago, and had been laid aside, as it was rusted solid when it came in. It was also different from any type of that make we had ever seen, and by the time we got it apart several new parts needed to be made.

Did you ever know how handy it is to know how much to allow for working fits in some places, to just have something that is all right to measure and make the other one like it? In this case the rust was too deep and some of the broken parts were jammed so badly that we had to make sizes to suit ourselves.

The pump was one of those direct-acting chaps, with a good-sized piston valve on top that cushioned in a chamber in the heads, the valve being smaller on each end where it entered the cushion chamber. As we figured it out, this chamber acted simply as a dash-pot to keep the valve from hitting hard at the ends of the throw. It was thrown by the steam and went pretty hard. After some figuring and trying, we got it going very nicely, so much so that the owner declared it the nicest-running pump he had ever seen, and as he was a man that always paid his bills promptly it made us feel good.

It ran for some time very successfully where it was taken. After several months the owner came in one day and said they had moved it to another place and it just refused to run; it had run in a kind of half-hearted way, he said, for a couple of days and then just quit, and they needed it in the worst kind of a way.

It was a miserable, cold, rainy day and I hated to ask anyone to go out and hunt over that pump, and as I had done most of the figuring on it myself I thought I could make a short job of it, and concluded to go myself. The owner had business in another direction, but he told me where to go and how to find a man there who ran it. I found the place and the man, and told him to get up steam. The boiler was a portable one, standing out in the rain about two hundred feet from the pump, also in the rain. Directly in front of the boiler, and about ten feet away, was a small board shanty about 8x12 feet, and this was the only shelter anywhere near. I stayed in it until the steam began to rise, and then I went out to the

FIG. 1. THE POND.

FIG. 2. THE GROUNDS.

pump and took out the piston valve and wiped it dry and put it back. I believed that valve was sticking because of too much or too thick an oil. When I got back to the shanty to see how the steam was coming up, I found things humming and wood and oil and coal making a great fire. As the boiler had only one good gage cock—and that the top one—which showed rather blue, no steam gage, and the safety valve weighted down with an assortment of old iron of all shapes and of unknown weight, the steam that hissed out at various rivets and joints did not add materially to my peace of mind.

"I say, my friend," I remarked, "ain't you a little afraid of that boiler?" I got off to one side as I spoke, as I thought her more apt to go endways than sideways. My friend regarded me with a look of mingled pity and scorn.

"Afeared of her? I haint afeared of no boiler that ever was. That water is just exactly at the second gage, a little low, and a good man don't have to depend on none of them jim-cracks of steam gages. I never saw one that would stay good for two weeks." (I don't believe I did, either, if he was near it.) "I have fired boilers till they just danced up and down, and I hadn't seen the water for an hour, and burnt them till they all bagged down in there [pointing to the firebox]. I tell you they have to go when I get aholt of them, or I'll know why. I guess you don't know me, if you think a boiler could scare me," he concluded, as he swung open the door to hurry up the fire.

I made up my mind that some young lady might not have a chance to get a good machinist for a husband some day if I stayed too close to that boiler, and so I started for the pump, feeling glad it was off sideways. I got to the far side of it, where I could keep my eye on the boiler, and wondered if I would have time to dodge a piece that might happen to come just in my direction.

On trying the pump it ran all right. I then got some of the oil that was used to lubricate it, and put in a very liberal dose. A few minutes of that treatment and she refused to work. A few minutes' work with a flat bastard file on the cushion ends of that valve made things loose enough so that thic's oil wouldn't phase her. If some fellow gets her that uses good oil and only enough, that valve will pound, and he will blame the blockhead that fixed her, and maybe take his work to Rouseville if he knows I am the fellow; but I must take the chances.

After getting everything in running shape, I started down over the hill, expecting every minute to be trying to locate the landing place of part of a boiler, and I didn't feel safe until quite a distance away. As I never heard of him getting blown up, I begin to believe that children and —— (some folks that know less than children) are let live in spite of themselves. That was how I caught cold.

W. OSBORNE.

A Millionaire's Pastime.

BY TECUMSEH SWIFT.

The beginning of the new century has been a serious time with me, and has brought with it a new and perplexing problem. What shall I do, and how shall I occupy myself when I become a millionaire? It looks as if this is going to be a millionaires' century, and of course I have to be in the swim. Perhaps the best thing I can do, if not the only thing, so far, is to notice what other millionaires are doing; and this is a report of a little that one of them has been occupying himself with this winter.

A man apparently sixty years old, of average size and thin or wiry frame, with little, sharp, shifting eyes, and dressed in the everyday garb of an outdoor carpenter or journeyman millwright, is the richest man by far in one of the cities of New Jersey. It is said that once upon a time he was upon the witness stand, and being asked what his occupation was, he replied that he was "president of banks," which was probably as correct an answer as he could have given, as he actually is, or was, president of several such institutions. In the suburbs of the city he has a residence and considerable land, from which are obtainable such picturesque views as Figs. 1 and 2. The level of the pond in Fig. 1 is considerably above that of the dam seen under the bridge in Fig. 2 (say, 8 feet). Between these two is located the building seen in Fig. 3. This building is a sawmill which has been erected and equipped under the personal supervision of the millionaire aforesaid, whom for short we may call Mr. M., and whose mill is to me an extremely interesting installation.

Upon the site of this building once stood a grist mill, which was burned down a long time ago, everything being destroyed but the water and the water-wheel, with a short stump of the shaft of the latter. The idea which apparently has ruled in the fixing up of the mill has been to do everything by primitive methods and with the avoidance as completely as possible of all modern facilities. The frame of the building was of timbers split from trees felled on the ground, and hewn only on the sides on spots which functionally required it. The boss tells with pride that the building was put up in three days, and the proprietor of a big printing press manufactory in the neighborhood told him that it looked like it.

The most wonderful piece of work, perhaps, that I ever saw was the splicing of the upright shaft of the water-wheel. The surviving stump of the old shaft was dressed off obliquely, and the trunk of a tree was found of the right size, and doing nothing to the outside of it but to peel the bark off, this was also beveled, and then the two pieces had two or three wrought-iron hoops slipped over them and they were secured by wedges all around, wedges of all shapes and sizes and fitted in upward, downward and at various uncomfortable angles. Then there was a bevel wheel, 5 or 6 feet in diameter, similarly wedged on to the tree trunk further up, and above this a "winged gudgeon"

was fitted into cross slits in the top end of the shaft and fastened with other hoops and wedges. The box for the upper end or journal of the winged gudgeon was against the side of the sill of the building, and a wooden cap completed it. Fig. 4 tries to give us a glimpse of the water-wheel shaft as seen by squinting in under the floor.

The horizontal iron shaft was set in two wooden boxes without caps, placed one on a crooked cross-timber and the other on the sill at the other side of the mill. Mr. M. assured me that caps were not necessary. I noticed that the rim of the bevel wheel, about 2 feet in diamteer, on the horizontal shaft was broken clear through between the teeth and sprung open about 1/8 inch; but that probably made no particular difference. On this horizontal shaft was also a six-armed spider, and upon this had been built a wooden rimmed wheel about 8 feet in diameter, the face of which had been turned in place, apparently perfectly straight, by running the water-wheel. A 4-inch double-crossed belt went from this big wheel to the saw pulley, about 5 inches in diameter, and the resources of untraditional engineering were suggested in the method adopted for compelling the belt to remain on the pulleys. A ladder, made on the spot, the sides the halves of a young tree which had been skillfully split, was set up ostensibly to lead to a half-floor overhead. It stood in a crooked and careless attitude, but incidentally one side of the ladder crowded the belt, while the lower end straddled in through the belt and did the same service for the other side of it. The belt was fearfully and wonderfully made. Some old single belt had been secured from somewhere, and this had been glued together and plentifully copper riveted to make the double belt. Fig. 5 shows the saw bench, which probably once confessed to companionship with a railroad horse-power at some backwoods station. When I looked in, Mr. M. was filing the saw, and when I asked him what he intended to saw with it, he said, "wood."

The wood to be sawed is seen lying ready outside the mill in Fig. 3. The large pieces have to be split and chopped to cord-wood length before they go to the saw. Some wood has actually been sawed, but when all is finished, there is practically no water to run the mill, except for half an hour or so every few days. Fig. 6 shows the operating mechanism of the gate. This is of course entirely outside the mill, but a door has been cut in the corner to make it easy of access. In one corner of the mill is a blacksmith's fire with a large bellows and anvil and a grindstone, so that anything further required in the line either of construction or maintenance can be easily fabricated.

The erection and complete equipment of this interesting mill has been done without the aid of any draftsman or professional engineer, but it goes all the same. Our friend has had a good time; so good, in fact, that I was told he declined to accompany his family to Florida until the job was done. I have an idea that he has thus got more satisfaction out of his liberty and ability to do as he pleases than some others succeed in extracting. He, by the way, was a sawmill man in Pennsylvania a generation ago when oil was struck on his land, and that's where his money comes from and his predilection for his recent pastime.

FIG. 3. THE MILL.

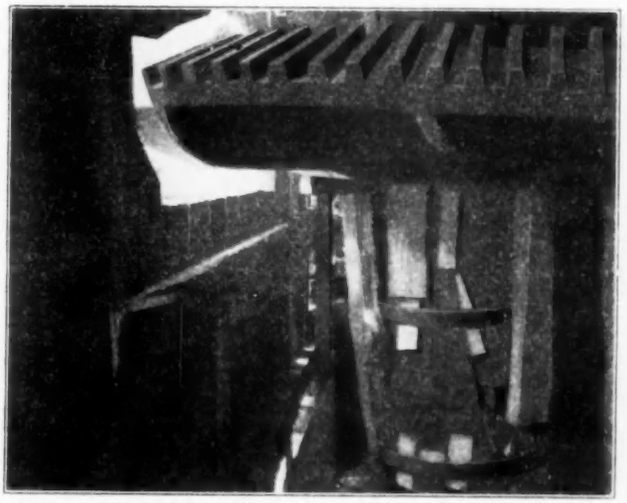


FIG. 4. THE SPLICE OF THE SHAFT.

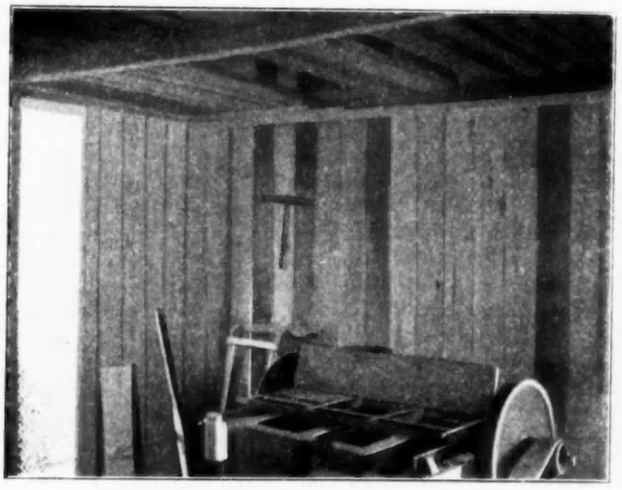


FIG. 5. THE SAW BENCH.

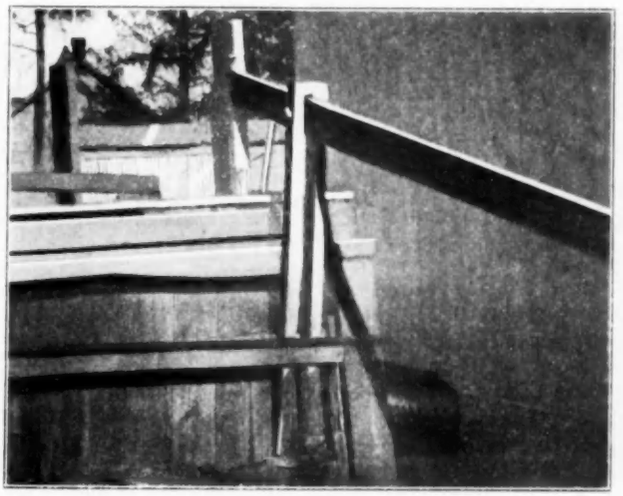


FIG. 6. THE GATE LEVER.

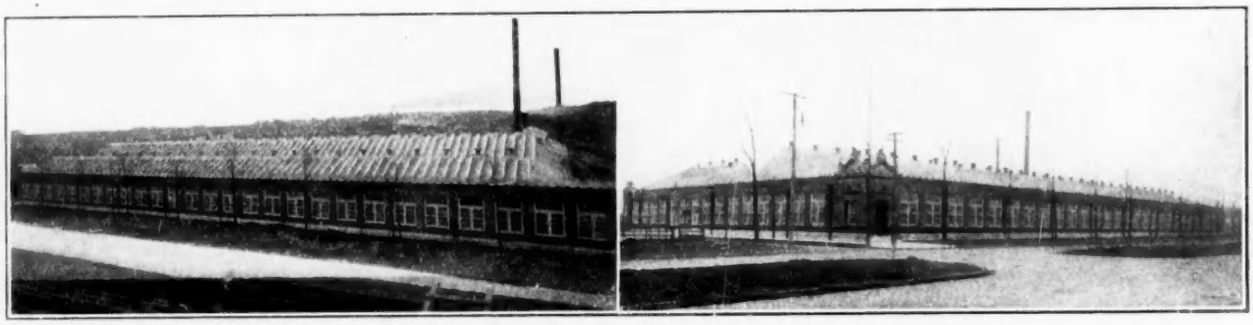


FIG. 1. EXTERNAL VIEWS OF THE BOYER MACHINE COMPANY'S WORKS.

The New Detroit Shops of the Boyer Machine Company.

The growth of its business in pneumatic appliances of various kinds compelled the Boyer Machine Company—whose products reach the public chiefly through the Chicago Pneumatic Tool Company as sales agents—to seek new quarters, and about a year ago an entire removal of the plant to Detroit, Mich., was decided upon. The reasons for the decision in favor of Detroit we do not know, though we fancy that the attractiveness of the city as a place of residence was not the least, for Detroit combines the advantageous features of an Eastern and a Western city to a conspicuous degree. With the broad avenues and shade trees and general spaciousness of the typical Western city, it possesses a freedom from smoke which is quite unusual, and with this there naturally goes a general cleanliness and well-kept appearance which are very attractive.

The removal decided upon, plans for new buildings to be made "out of the whole cloth" were laid out, and these, with some of their interesting features, it is our privilege to show and describe. The first point to which the machine shop designer nowadays devotes his attention is the securing of as liberal an entrance-way to nature's daylight as possible, and the first thing which strikes the visitor to the Boyer works as he approaches them is, the means by which this is accomplished.

The Boyer roof, which, with many other features, is due to Mr. Doughty, the superintendent of the works, is a modification of the now familiar saw-tooth, the modification overcoming the only objections that have been raised against that form of roof, and this without sacrificing any of its good points. The roof may be described as a combination of gable and saw-tooth. The roof framing is trussed, and may have as great a span as any trussed roof. The saw-teeth are mounted on this framing, the ridge lines and valleys of the teeth being parallel to the rafters and inclined to the ground. The effect of this construction is to do away with the numerous posts which commonly accompany the saw-tooth roof and to leave an open and free shop. The actual width of the shop is comprised of two such sets of trusses with a valley and a row of posts between—these posts corresponding in position to the row under one edge of the monitor when that style of roof is used. The row of trusses next the street has a span of 39 feet, and under it at one end are the offices and beyond these the erecting and tool-room departments. Parallel to this bay is a second one, 53 feet wide, under which are the various tools. The second set of trusses carries numerous I-beams for supporting the line and countershafts, and as these are very numerous, this set of trusses has a row of posts down the center of the shop. The end of the second set of trusses farthest from the street is carried by columns which are built into a curtain wall of brick. The removal of this wall will give the same facility for enlargement in that direction as exists with the regular saw-tooth, and the same remark, so far as the structure is concerned, applies to increase of length, although in the present instance increase of length is prevented by the streets against which the building abuts. When this enlargement has been made, the general section of the shop will be substantially the same as with the monitor roof, except for the row of posts down the center of the middle bay; and in the case of a shop intended for heavy work, the middle bay being fitted with a crane and the roof having no shafts to carry, this row of posts would be omitted, and thus leave as clear a floor as the monitor form of roof.

Fig. 1 shows two external views of the building—the left-hand one from the northeast and the right-hand one from the southeast. The two views show the general form of the roof distinctly. Fig. 2 is a view looking down the valley of the roof from the northand shows the glazing of these lights to be of ribbed glass, as indeed are the side windows. The saw teeth will be seen to be much smaller and correspondingly more numerous than is usual. This construction lends itself more readily to the trussed supports than does the larger saw teeth, and it also accomplishes another object, namely, the suppression of the drafts which are sometimes found to attend the usual construction in cold climates and to be very annoying. The breaking up of the skylight area into many small parts is found to entirely prevent the pronounced downward current which sometimes falls from the few large surfaces commonly employed. Figs. 1 and 2 show also the numerous ventilators on

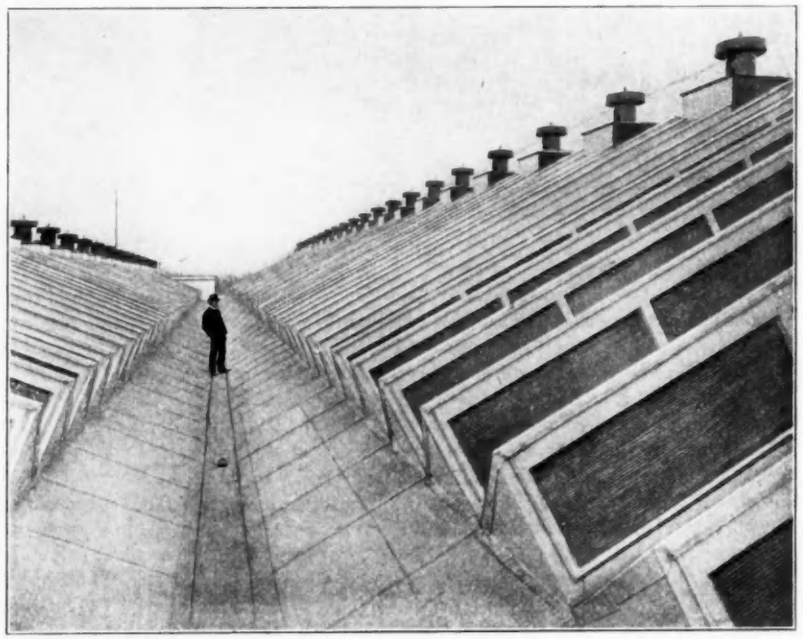


FIG. 2. VIEW LOOKING SOUTH IN THE VALLEY OF THE ROOF.

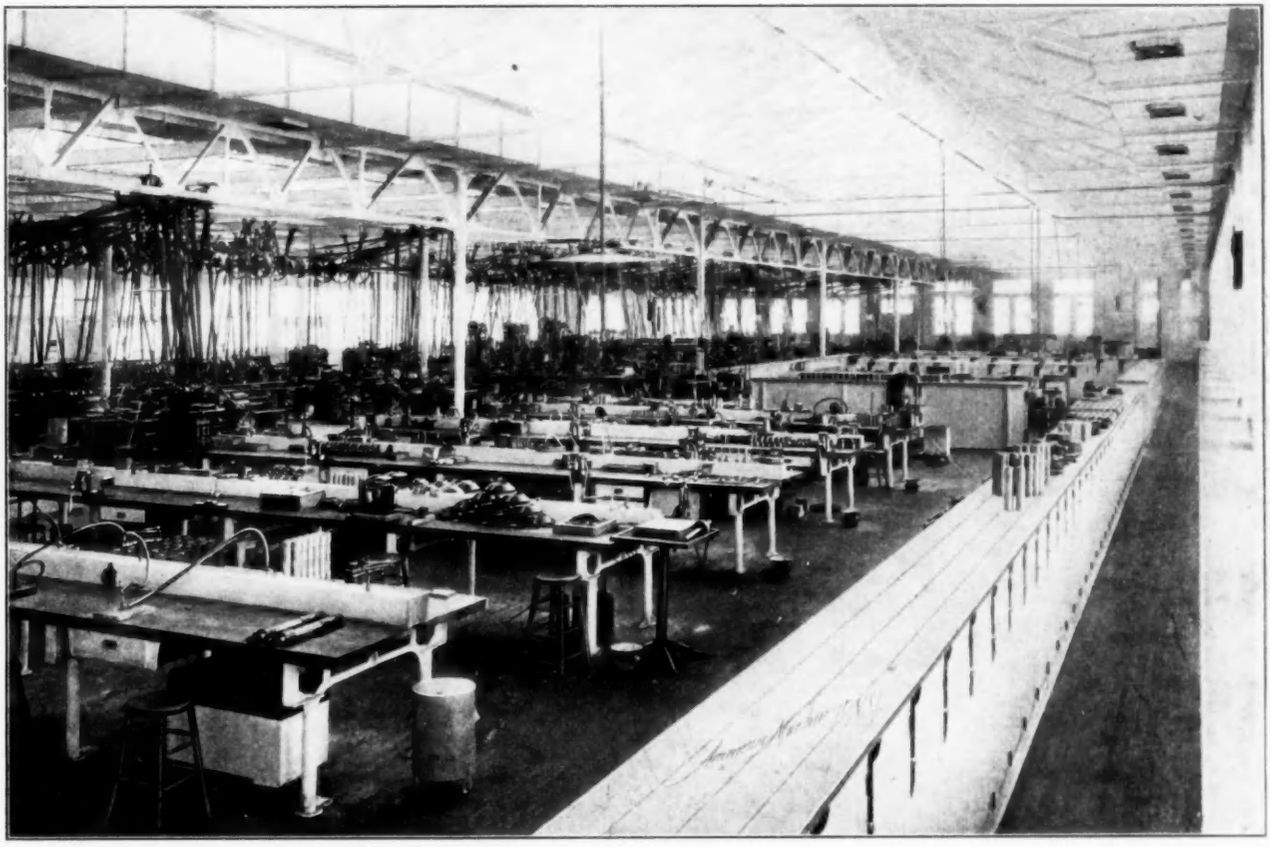
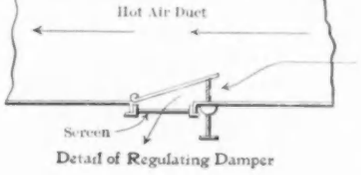


FIG. 3. INTERIOR VIEW, LOOKING NORTHWEST.

the roof with a wire connection by which they may be opened or closed from within the building. In the foreground of Fig. 2 and also just behind the man standing in the valley are wire cage covered holes for the storm water which is discharged through the columns which support the roof. Fig. 3 is an interior view looking toward the northwest corner. In the foreground are the assembling benches and just beyond is the toolroom. The appearance of the roof from within is plainly shown in this view. In the angles between the rafters and the bottom chords of the roof trusses are the ducts for distributing the air from the hot-blast apparatus in the engine-room. These ducts are of trapezoidal cross-section, are out of the way and far less obtrusive than in many shops. Fig. 4 shows further details of the heating system, among which are the regulating dampers for securing an even distribution of the heat. The steam coils and fan are placed in the engine-room, located at the extreme northwest corner toward which the observer is looking in Fig. 3. The provision for returning the air from the



Detail of Regulating Damper

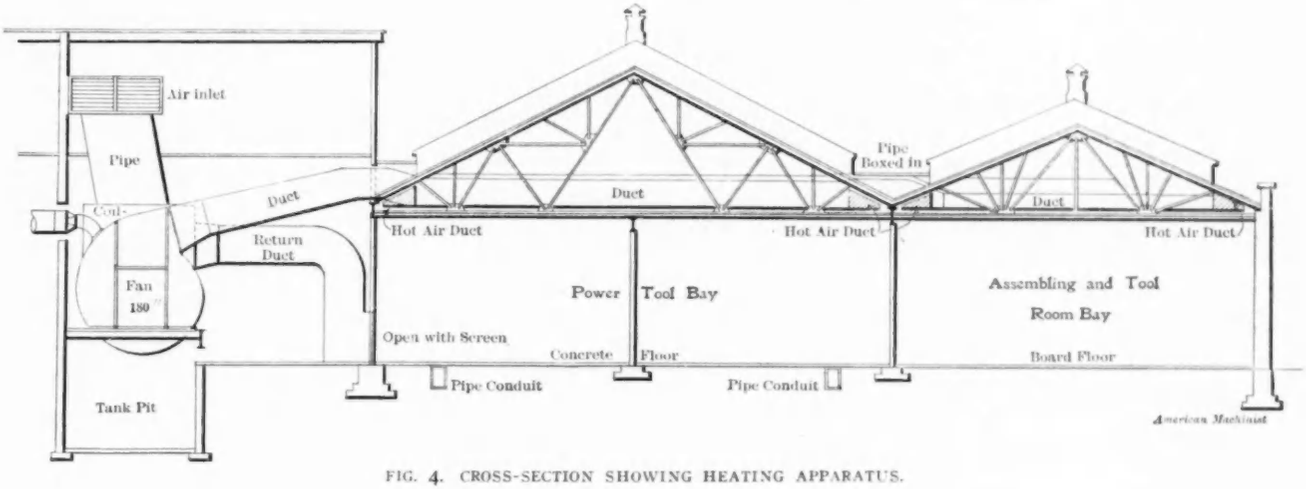


FIG. 4. CROSS-SECTION SHOWING HEATING APPARATUS.

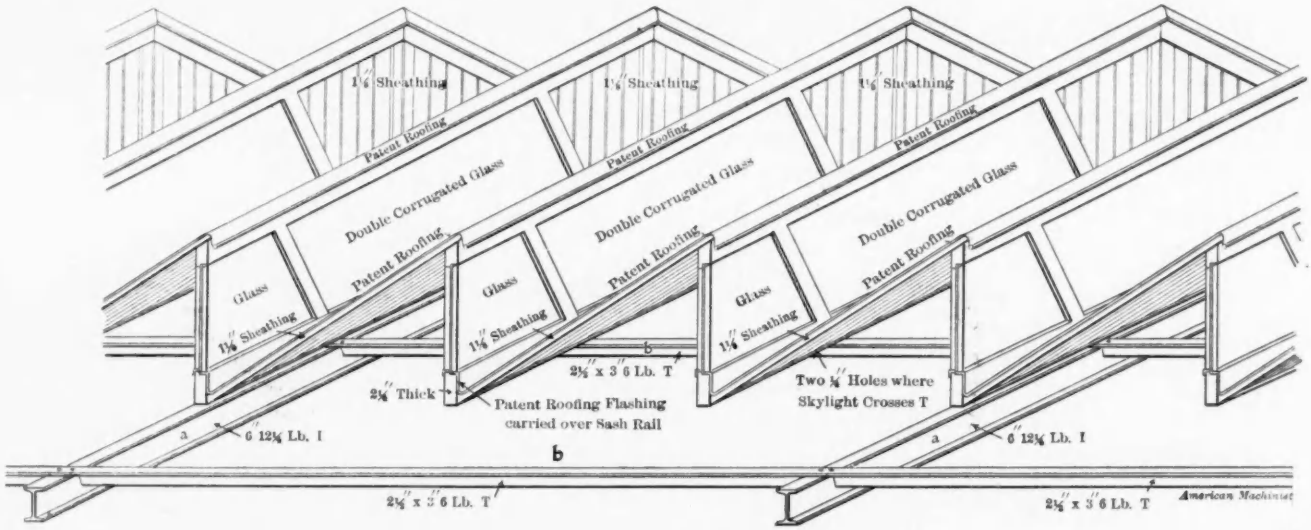


FIG. 5. ISOMETRIC VIEW OF ROOF FRAMING.

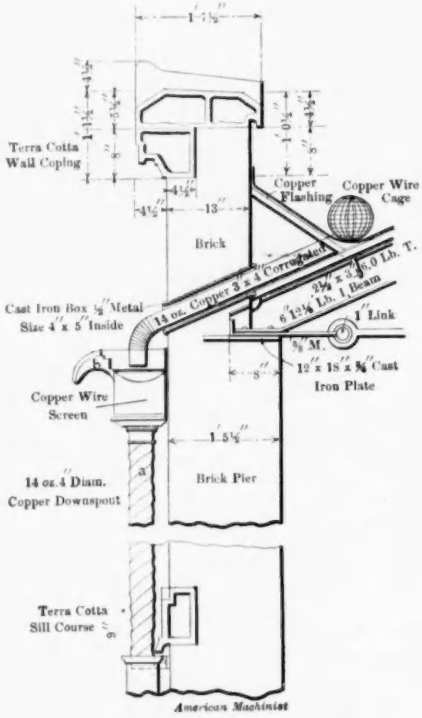

Terra Cotta Wall Coping
Copper Flashing
Copper Wire Cage
Brick
Cast Iron Box ½" Metal Size 4" x 5" Inside
14 oz. Copper 3" x 4" Corrugated
6" 12¼ Lb. I Beam
1" Link
⅝" M.
12" x 18" x ¾" Cast Iron Plate
Copper Wire Screen
Brick Pier
14 oz. 4" Diam. Copper Downspout
Terra Cotta Sill Course
American Machinist

FIG. 6. STORM WATER SPOUT.

shop to the blower is seen in Fig. 4, as well as that for taking the air either partially or entirely from outside.

Fig. 5 is an isometric view of the roof framing. The rafters *a* are pitched about 12 feet apart, the sash and roof boarding being supported on purlins *b*. The pitch of the saw teeth is about 4 feet. Fig. 6 shows a detail connected with the disposal of storm water from the outer sides of the roof. This water discharges through the copper leader *a*, but should this become choked with ice, as it sometimes will, the spout *b* will take care of it and prevent the water from running down the side wall and freezing there.

Fig. 7 shows the method of supporting the countershafts without drilling holes in the iron work. A series of eight-inch I-beams, pitched 8 feet 10 inches apart, one of which is shown at *a*, is placed across the bay containing the power-driven tools. For a countershaft support a pair of six-inch channel beams, one of which is shown at *b*, is placed across the span, resting on the lower flanges of the I-beams as shown. A clip *c* is fitted with screws *d*, which act as bolts to bolt the clip in place and also as set-screws to secure the channel beam. Straps *e* and *f* with bolts *g* bind the hanger to the channels. At *h* is the shipper pole support.

The artificial lighting is by gas. Welsbach burners in groups of four, seen in the interior views, supply the general illumination, while ordinary gas jets are fitted for the various tools. The Welsbach burners have not been entirely satisfactory, as the jar of the roof framing leads to a short life of the mantles. It is intended to fit the hanging pipes with a flexible spring support to obviate this. The main pipes for these burners are supported by the roof trusses, as shown, but the mains for the lights for the tools are carried in conduits below the floor. These conduits also carry supply and return pipes for oil and soda water, which are supplied under head by a pair of vertical-geared plunger pumps located in the engine-room. A compressed-air pipe is also placed in the conduit.

The bay containing the power-driven tools is supplied with a continuous concrete floor 9 inches thick, the composition used being that known as granitoid. This floor extends to nearly the entire width of the bay, and along both edges of it are the pipe conduits. The cover plates over the conduits may be seen in Figs. 8 and 9, which show the automatic screw machine and the grinding departments respectively. Fig. 10 is a detail of the pipe conduits in plan and cross-section and shows the

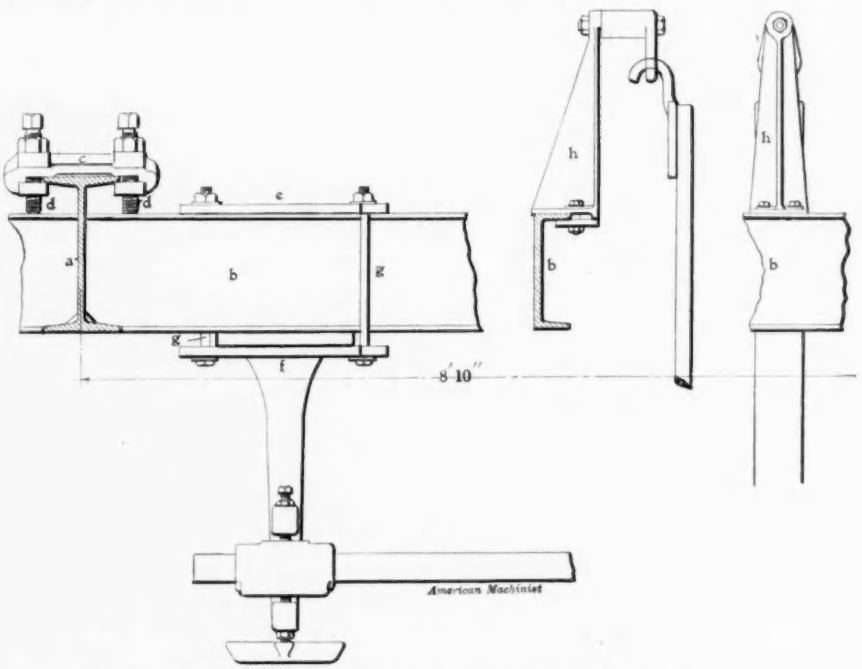


FIG. 7. COUNTERSHAFT AND BELT SHIPPER POLE SUPPORTS.

FIG. 8. AUTOMATIC SCREW MACHINE DEPARTMENT.

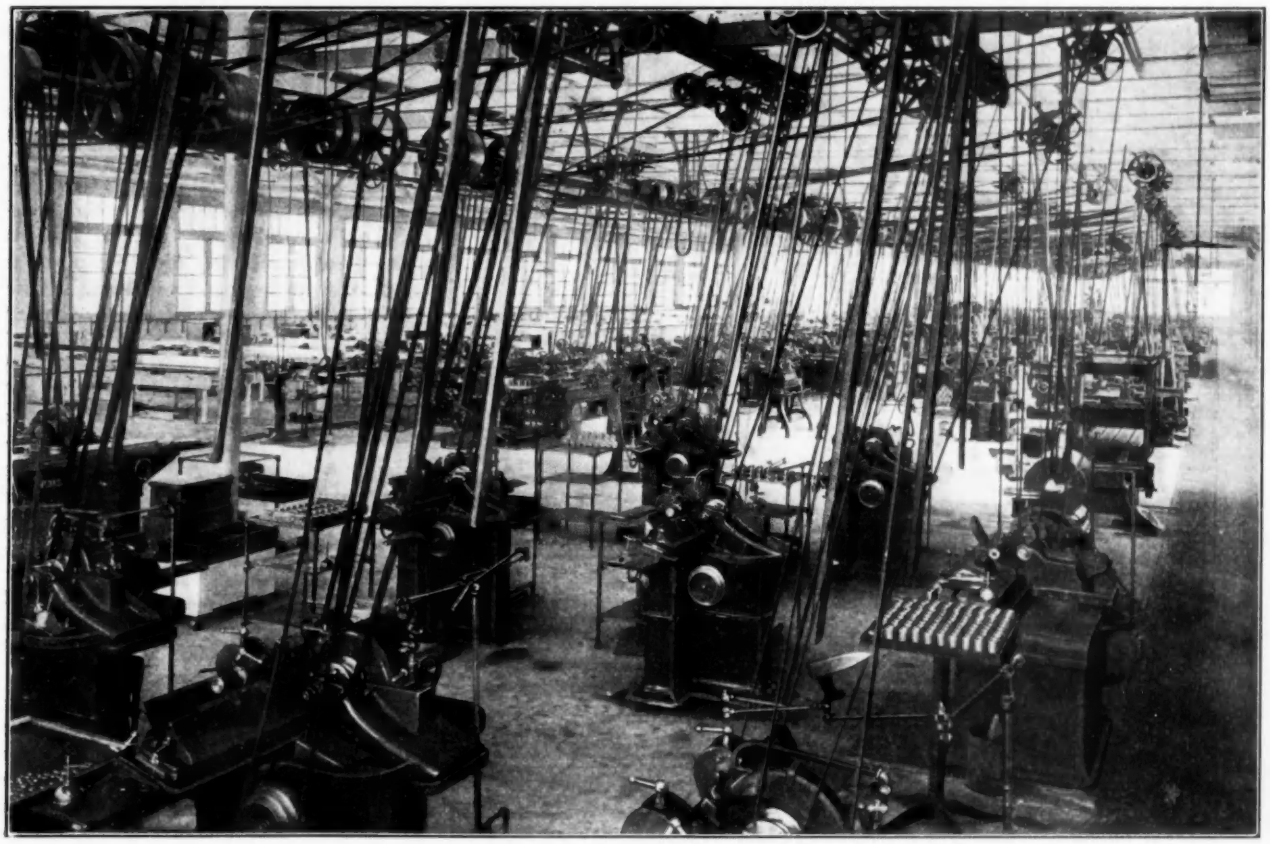


FIG. 9. GRINDING MACHINE DEPARTMENT.

method of supporting the cast-iron floor plates which cover the conduits, and which may be readily removed far across to the pipes. Smaller conduits, *a*, Fig. 10, are laid across the shop below the floor at frequent intervals. In them the branch pipes to the tools are laid.

An annoying feature of this general oil supply system as usually installed grows out of the liability of the strainers in the pans under the tools becoming clogged with chips unless constantly watched. When this happens the oil soon fills the pan and there is presently a pailful or more on the floor. Fig. 11 shows a very simple and effective method of overcoming this difficulty. The ordinary outflow is at *a*, but in addition to this a second one is provided at *b*. It is scarcely possible that both should become clogged at the same time in any event, but this is made still less likely in the present case by the fact that the second outlet is raised above the bottom of the pan and so does not come into use at all unless the first one be clogged. Moreover, being elevated, the accumulation of oil in the pan when the first outlet becomes clogged calls attention to the fact and leads to its being cleared. A sediment chamber *c* collects many of the chips that may find their way through the strainer *a*. For the newer machines using oil in a flood, orders were given the makers for much larger pans than those usually supplied. The automatics in the foreground of Fig. 8 happen to be old ones with small pans, none of those having large pans being in position to show in the picture, but the new pans completely surround the machine and really keep the oil off the floor.

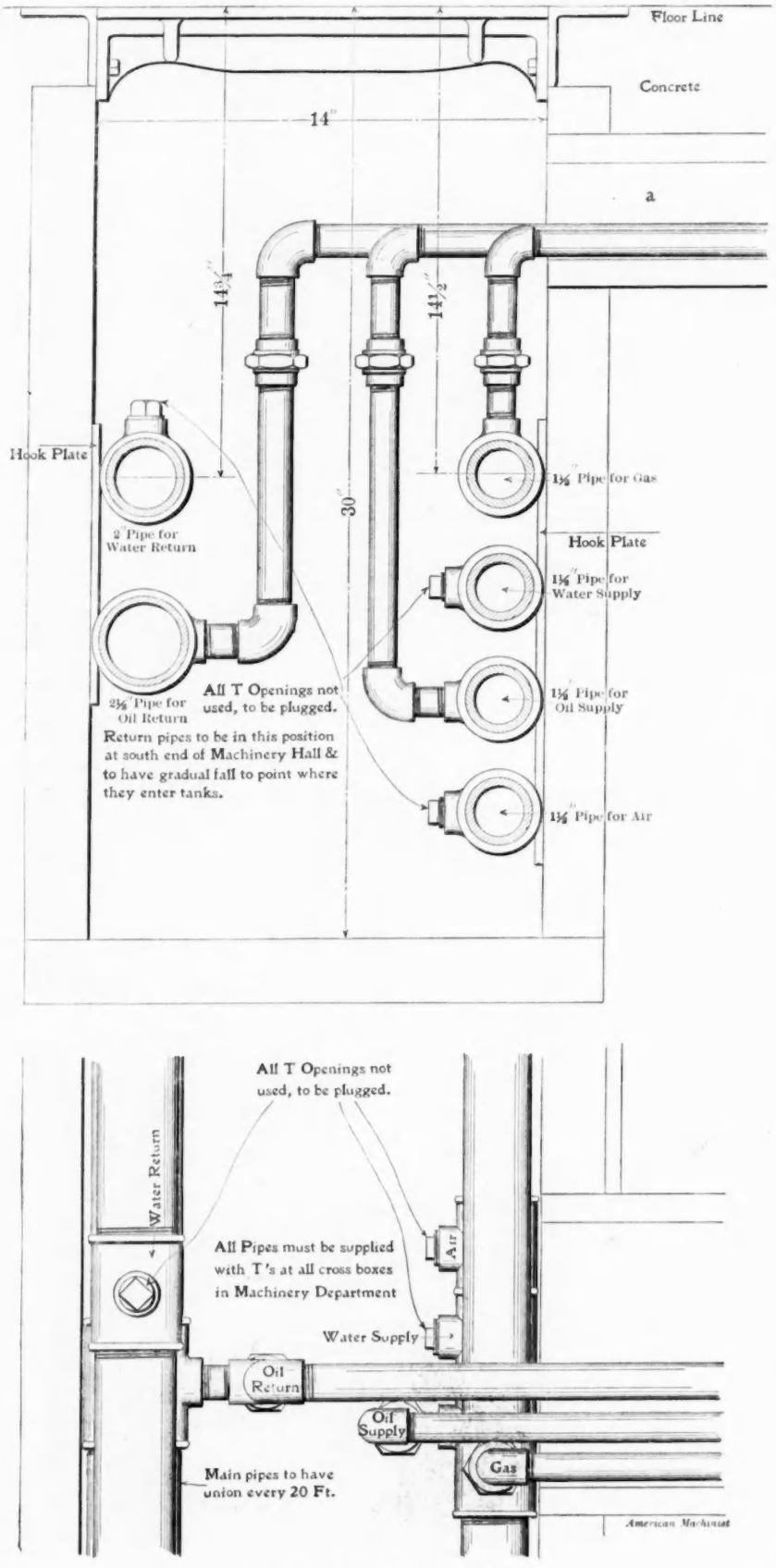

Floor Line
Concrete
14"
a
14¾"
14½"
30"
Hook Plate
2" Pipe for Water Return
1½" Pipe for Gas
Hook Plate
1½" Pipe for Water Supply
1½" Pipe for Oil Supply
1½" Pipe for Air
2½" Pipe for Oil Return
All T Openings not used, to be plugged.
Return pipes to be in this position at south end of Machinery Hall & to have gradual fall to point where they enter tanks.
All T Openings not used, to be plugged.
Water Return
All Pipes must be supplied with T's at all cross boxes in Machinery Department
Air
Water Supply
Oil Return
Oil Supply
Gas
Main pipes to have union every 20 Ft.
American Machinist

FIG. 10. DETAIL OF PIPE CONDUIT.

Fig. 12 shows the arrangement of pump, tanks and pipes for the oil and soda-water supply. The return pipes from the shops go directly to the closed tanks which are in duplicate and are located in a pit under the heating apparatus shown in Fig. 4. The discharge is into large catch basins with wire strainers over the tanks. Two tanks are provided for both oil and water to permit cleaning without interrupting the operation of the system. Suitable valves enable either tank to be used as desired and a manhole in the head permits cleaning. As the catch basins are open a surplus amount of oil in the system would lead to an overflow at night when the material all drains back to the tanks, and, to prevent this, equalizer pipes are provided on a lower level than the catch basins, so that even though one of the tanks of a pair be closed off the oil will go into it after the other one is full. The pumps deliver directly into the supply mains, but to provide for the variable rate of use and to supply the necessary constant head, a stand-pipe is connected to each main immediately after it leaves the pump. The capacity of the pump is such as to keep this pipe full under the heaviest demand and the surplus goes down the overflow pipe and back again to the tank. A short piece of vertical pipe will be seen at the top of the stand-pipe. This is open to the air and its office is to prevent the stand and overflow pipes from balancing one another, syphon fashion, and so neutralizing the head. Without this air connection the system would not work because of this action. The head provided is 19 feet 8 inches above the floor line.

The sanitary and lavatory conveniences

are equal to the best we have seen. Fig. 13 shows one section of the toilet and locker room, there being in all six sections like this. Above the lockers is a gymnasium floor which may be seen in this view.

We should also mention as an illustration of the general neatness of the whole plant that the interior is painted white. All the iron work had five coats of paint of which the last two coats were enamel.

A feature of the removal of the company from St. Louis should be mentioned. When the new shop was ready for occupancy the employees of the old works and their families were transported to Detroit at the expense of the company—a special train of six coaches being chartered for this purpose. Several packing and shipping concerns were engaged to prepare the household goods for shipment and to load them on the cars. The transportation of these goods and their delivery to the new homes of the men in Detroit was also paid for by the company. This was not done as a piece of philanthropy, but as a piece of good business. The company reasoned that to do this and so secure the removal of practically all their force to the new site would, in the long run, cost less than the delays, mistakes and lessened output which would inevitably attend the breaking in of a new force. The action is, however, none the less commendable on that account, as we think very few concerns under similar circumstances would have looked at the matter in the same way.

The architect of the building was Louis Mullgardt, of St. Louis, and the consulting engineer in charge of the power and heating plant design and installation was S. E. Freeman, of the same place. The heating and ventilating plant was constructed by the American Blower Company, of Detroit.

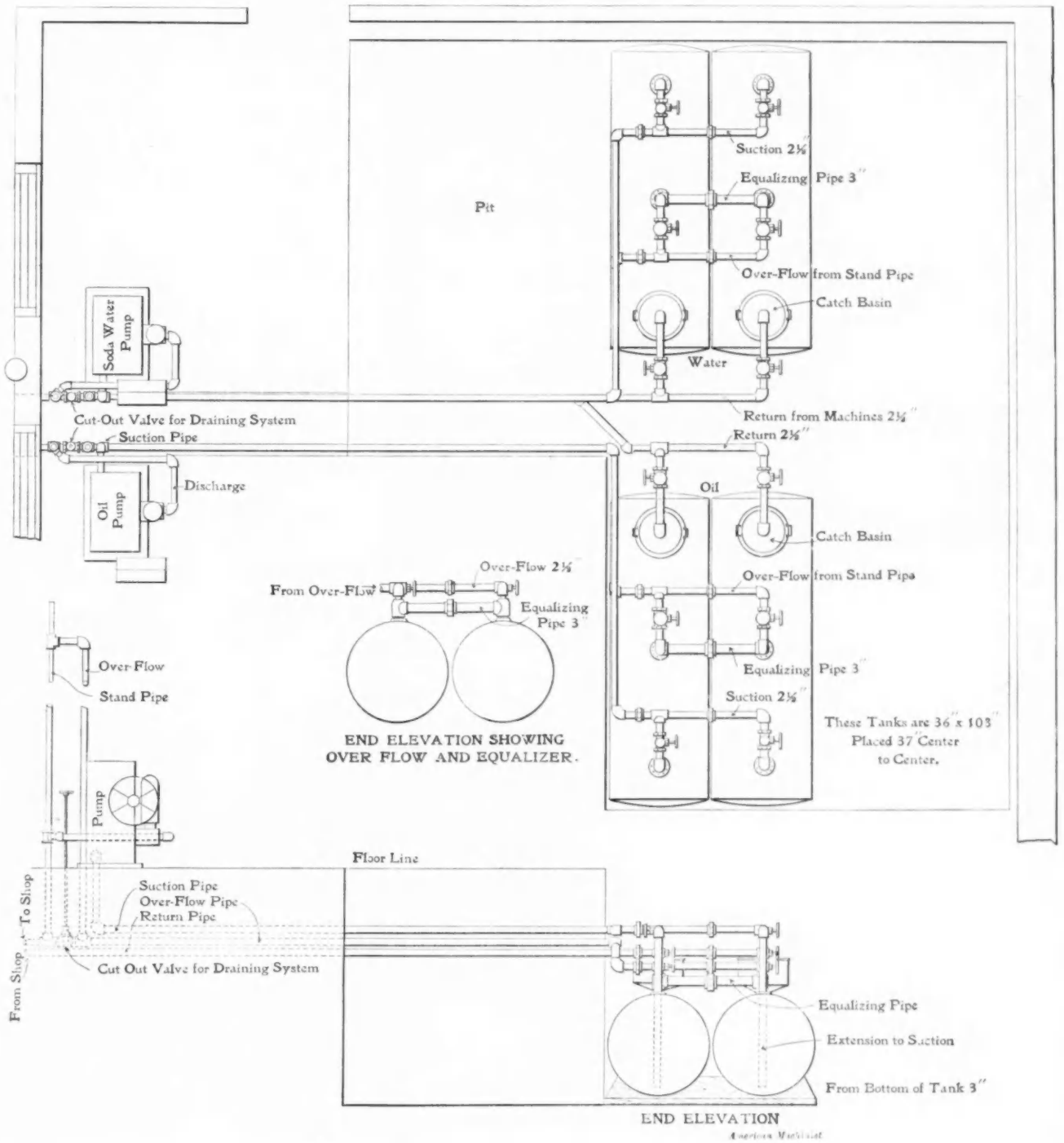


FIG. 12. OIL AND WATER DISTRIBUTION SYSTEMS.

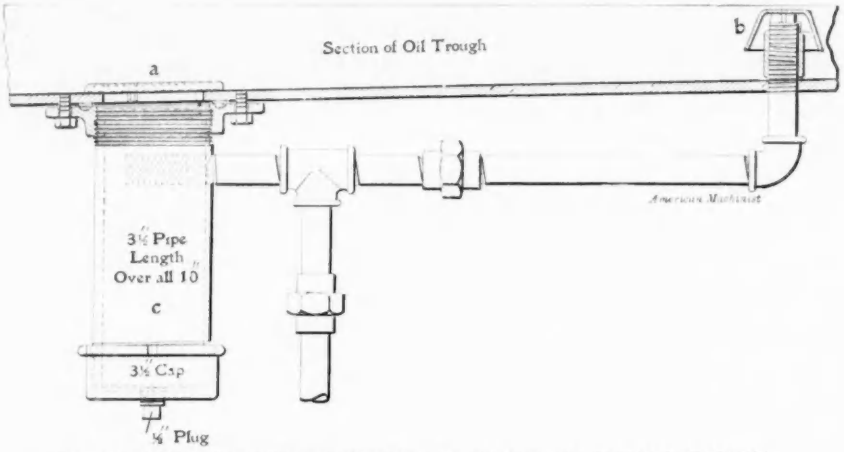


FIG. 11. DRIP PAN WITH ARRANGEMENT OF OUTLETS TO PREVENT FLOODING.

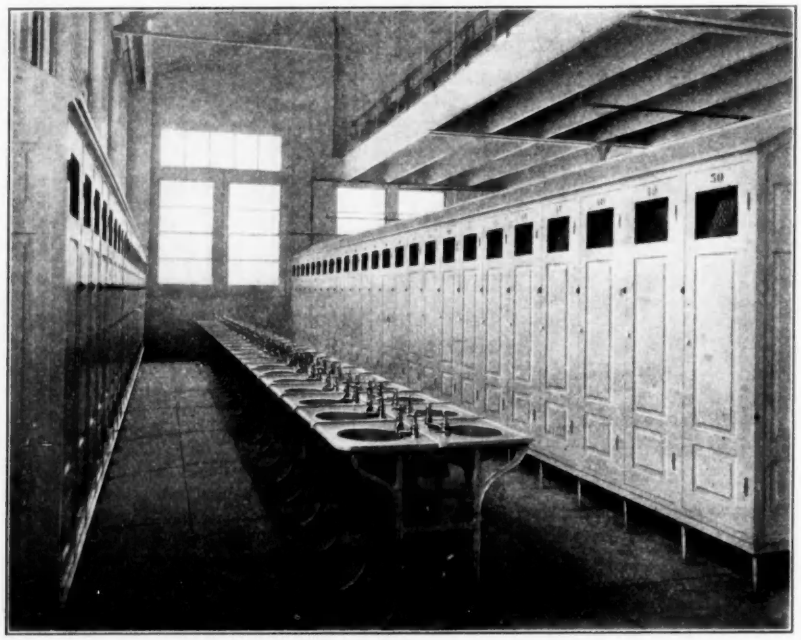
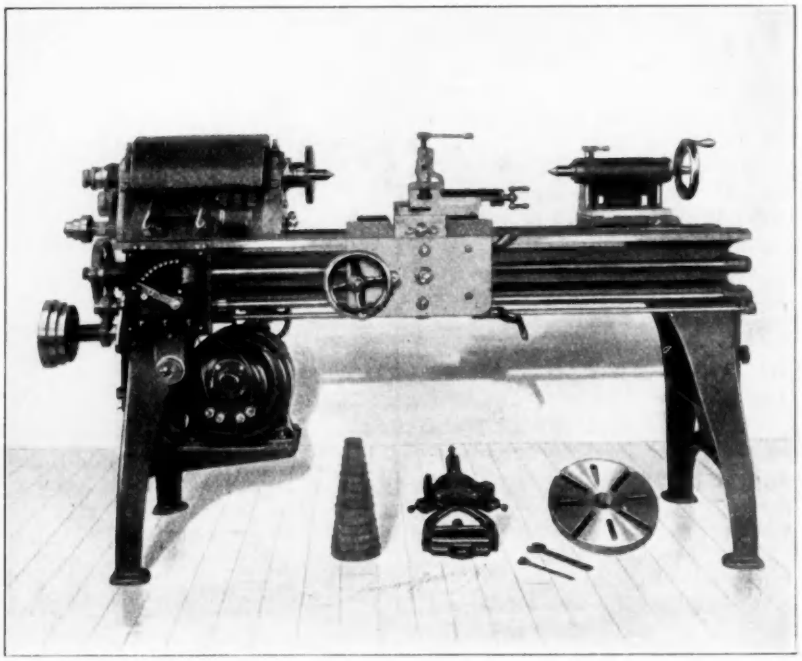


FIG. 13. ONE OF SIX SECTIONS OF WASH-BASINS AND LOCKERS.

A Motor-Driven Prentice Lathe.

We give herewith a view of a lathe built by the Prentice Bros. Company, of Worcester, Mass., to which has been attached a high-speed motor, as shown upon a shelf attached to the legs of the lathe, so that the motor is under the headstock and from it the motion is transmitted by means of a vertical shaft and bevel gears to gears placed upon the spindle, and which are so arranged that by the movement of the levers controlling the clutches the various spindle speeds are obtained, the same as with a cone pulley, only the change from one rate to another is more conveniently made than is usually practicable with the cone pulley. The spindle is back geared in the usual way, except that in this case the back gearing is placed underneath the spindle. The builders of the lathe have designed this arrangement in the belief that it is best, all things considered, to use a small high-speed motor and arrange to run it at a constant speed; taking from it the motion required by means of the gearing before mentioned. The lathe illustrated is in all other respects the regular 14-inch Prentice lathe, the features of which are familiar to our readers. It will be noticed that the various controlling devices are conveniently located at the head of the lathe, just under the levers by which speeds are changed.



MOTOR-DRIVEN PRENTICE LATHE.

Rubber Patterns.

An "American Machinist" man noticed in the shops of the C. B. Cottrell & Sons Company a mass of a red substance which looked like rubber. Upon inquiry it was found to be the sort of rubber which dentists use in making plates for false teeth. This rubber is used there for making patterns or parts of patterns. Immersed in warm water for a time, it becomes very plastic and can be molded either by the hands or in any other convenient way into any desired shape, and when cooled becomes sufficiently hard to answer the purpose of a pattern. Changes are readily made in it, and one practice is to roll it in strips by means of rolls which have been made for the purpose, so that the strips are thinner at one edge, the amount of taper being sufficient for what the patternmakers call draft. Supposing, for instance, that a gear cover is to be made, the patternmaker walks up to the machine or gear, takes a strip of this rubber which has been warmed, bends it about the gear to get the desired shape, and holds it until cooled, when the pattern is practically made. The material is of course available for use over and over again, and it has proven to be a very excellent substitute for wood and other materials formerly used, especially for temporary patterns. In the work of the above-named concern (printing presses) this rubber has been found very useful, and it might prove to be so in other lines.

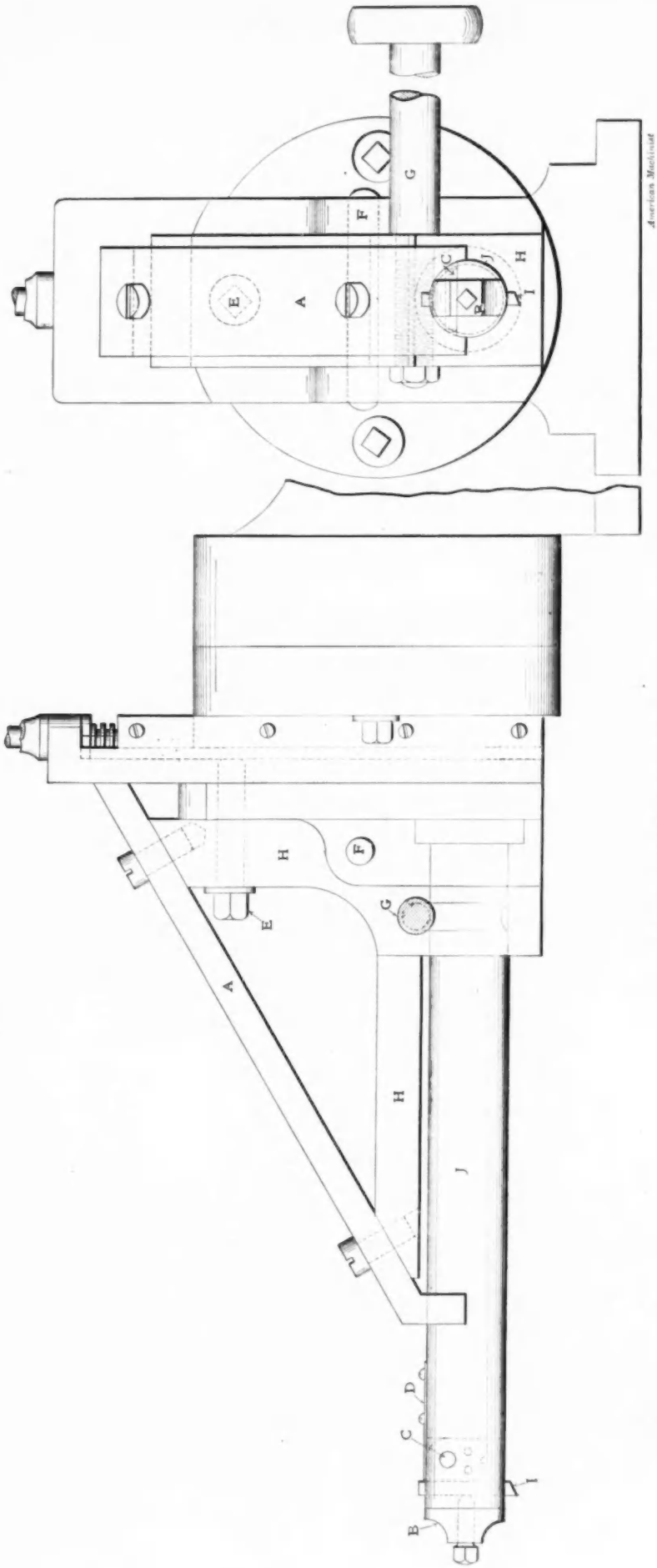


FIG. 1. ROTARY SHAPER TOOL.

Some Shop Tools.

BY A. H. CLEAVES.

DESIGN FOR A ROTARY SHAPER TOOL.

The accompanying Figs. 1 and 2 show an untried method of "my own importation" for planing or shaping out a half or any fraction of a circle, such as is frequently used in making a joint, forming dies for bicycle and similar work—a substitute for the regular full form chatter-tool held down with a crowbar in a gas pipe, applied to the tool-post.

The construction of the tool-holding device admits of the minimum radius, with strength; and for shorter work and smaller diameters a shorter and smaller tool-post can be used. The tool is made with a casting *H* held in the place of the regular clapper-block at the pivot *F* and at the swivel screw-slot by *E*. The rest *A*, braced against the slide-rest is solid with the casting *H*. The lift of the cutting tool *I* is obtained as shown. *B* is a steel block, with a slot milled in it for the tool. The slot is filled behind the tool with a piece of metal riveted in—a cheap way to get a square or oblong tool-post opening. This combination is hinged at *C*, and snapped back by the spring *D*; so the tool *I* always lifts in line with its cut, and can be easily adjusted to radius with a scale. For long shaper work an extension plate should go with the table, easily made and clamped to the same. The worm-screw *G* for turning *J* can be easily provided with a graduating device for inside gear or ratchet cutting. But the tool *I* must be made easily adjustable.

TOOL FOR INTERNAL GEAR CUTTING.

For an impromptu case of inside gear work a holder like *A* can be used, the outside of the ring *B* being marked in a milling machine. The set-screw *C* in these marks locates the work, and clamping screws *D D* fasten the same. The tool is always in one position vertically, and is gaged to plane to the bottoms of the teeth. *A* is held in the shaper-vise *E*.

AN ELLIPSE TEMPLET.

A friend told me how he made a correct ellipse with ½-inch minor and 1-inch major axes, by cutting the rod Fig. 4 1 inch diagonal, and marking around the form thus obtained.

FORMING A SQUARE-CORNERED INTERNAL RECESS.

The same person described a pretty cute die for forming an abrupt inside corner on a hollow cylinder with expanded recess like the sketch, Fig. 5. The piece A in its last forming process is compressed on the thin disks *B*, which are then pushed out by the plunger *C* of a compound press, *A* being held in the forming die *E D* all the time. The disks are thin to permit being forced out readily.

SOME COUNTERBORES.

"Men may come and men may go," but bores and counterbores go on forever (so

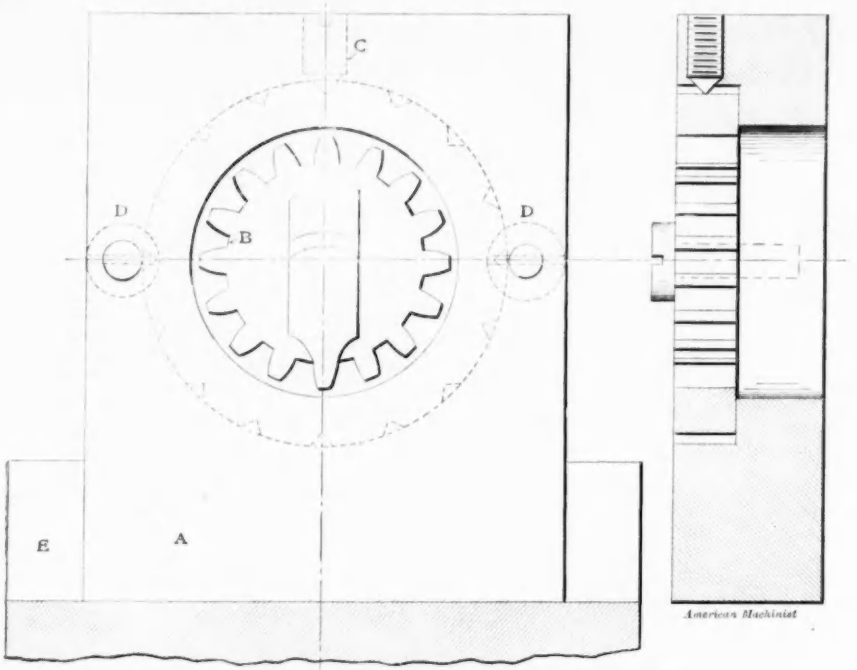


FIG. 3. FIXTURE FOR PLANING INTERNAL GEAR TEETH.

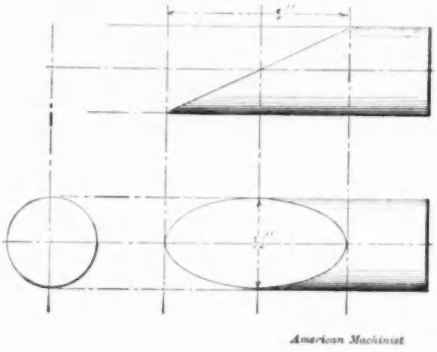


FIG. 4. AN ELLIPSE TEMPLET.

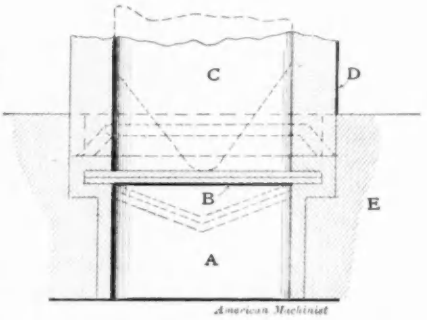


FIG. 5. DIE FOR FORMING SQUARE-CORNERED INTERNAL RECESS.

do the Boers). Fig. 6 shows what is said to make a good counterbore. A square-thread screw is cut a short length, and the pitch gives the clearance; the thread is cut crosswise for the lip of the counterbore, and ground with a round end lap of India oil-stone.

Fig. 7 shows a way to hold a drill or a guide-pin in a counterbore, or blade in a screwdriver handle. *B*, the drill, etc., is flattened at *A*, likewise *C*. The flat surfaces lock the drill, etc., and to prevent drawing out, the flattened end of *B* is turned over the angle on *C*.

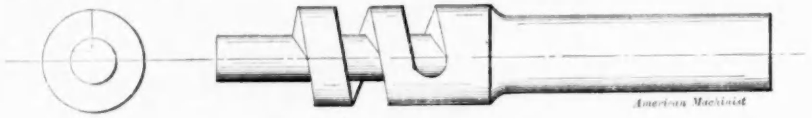


FIG. 6. A COUNTERBORE.

Fig. 8 gives a method of my own for holding small drills in connection with a counterbore or a countersink where the drills wear the fastest. The thread is left hand, so the drill tightens itself.

Figs. 9 and 10 are two views of another one of my ways of making a drill and counterbore in combination where used in quantities. The latter is slotted crosswise and the edges of the cutting lips brought opposite. The drill is flattened to fit this slot. The straight shank of the latter fits the socket *A* and both bottom in the holder *B*. The slot locks the drill and the holder backs it.

Figs. 11 and 12 illustrate a little tool for making very small counterbores, for jewel screw countersinks in watches. It had been the practice where I made this tool to center or point the counterbores and turn them in a staff lathe to get them true. But this little hollow mill in a sleeve did them better and faster. The counterbore *A* was 0.55 inch long; body, 0.046 inch; tit, 0.020 inch. *C* is the sleeve, *E* a hardened bushing, and *B* the hollow mill. *C* has two holes opposite the counterbore openings for clearance of chips. The counterbores are made on steel wire of the real size; and the tool makes the tit true with the body. Fig. 12 shows the sides of the counterbore being slabbed off with a small straddle mill or saw.

PUNCH AND DIE FOR CUTTING OFF BRASS TUBING.

In Fig. 13 *A* is the brass tube, cut off at *B*. *C* is the die. *D* is a depression-rest and guide. *E* is a rod for supporting *A*, and lifts up at *G* and swings around at *H* to remove the stock. *F* is a plug that recedes into the tube as the latter is pushed over *E*. *F* of course goes down with *D* and *I*. *J* is the punch.

BRASS TUBE SLITTING DIE.

In Fig. 14 *A* is the tube; *B* is a support rod and die combined; *C* is the shearing punch; *D* is the extracting rod. The punchings fall through the opening in *E* after the tube is removed.

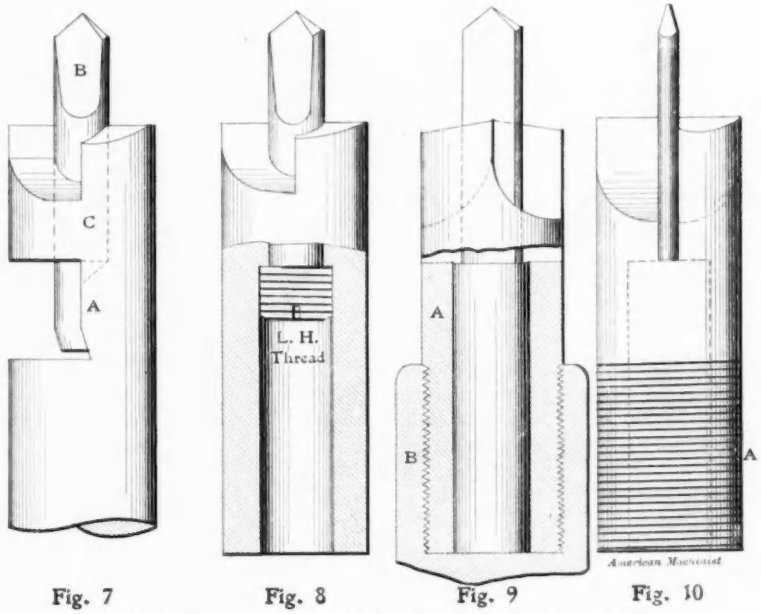


Fig. 7 Fig. 8 Fig. 9 Fig. 10

VARIOUS METHODS OF SECURING DRILLS IN COUNTERBORES.

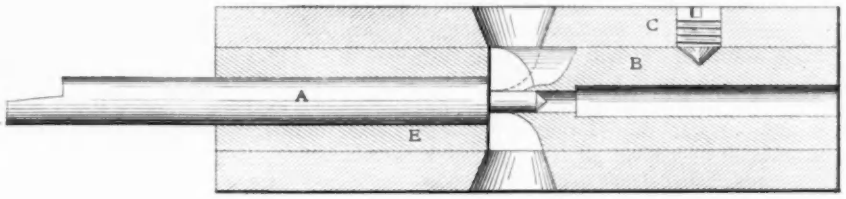


FIG. 11.

FIG. 12. METHOD OF MAKING VERY SMALL COUNTERBORES.

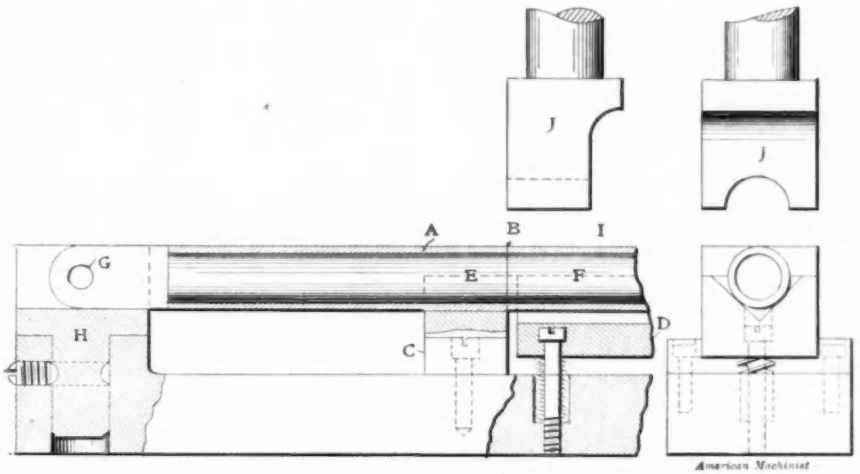


FIG. 13. FIXTURE FOR SHEARING OFF BRASS TUBING.

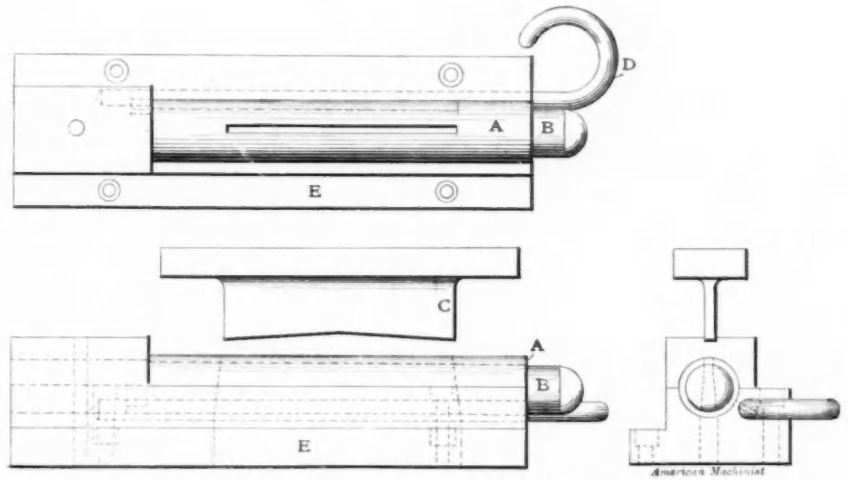


FIG. 14. PUNCH AND DIE FOR SLITTING BRASS TUBING.

Pump Troubles.

BY TIMOTHY BROWN.

Pumps are tricky things anyhow. There was a time when many of the pump phenomena that we get up against might have been explained as caused by witchcraft; but in this century that won't go, and we have to find some hydraulic or kinetic theory, or something else, to fit each particular case, and it does seem at times as though the homeopathic treatment, with monkey-wrench, packing and perseverance, was rather too mild, and we would like to administer a massage with a 10-pound sledge, and supplement it with a course of cupola elixir—if we had the time, and didn't need that particular pump right then and there.

One of my first encounters with a pump was about the time when I had arrived at the "know it all" stage; and if I had any idea when I went for that pump that there was any mechanical knowledge in the world worth having which was not already in my possession, I came back at least feeling that I was authority on that particular breed of pumps.

When I reached the place, I found a single-cylinder Knowles pump. I had never seen or heard of one before, and it may have possibly occurred to me, when the engineer said he had a machinist there all the day before who "had her all apart and couldn't make her pump," that I might get points on so simple a thing as a steam pump before I got through. "She ran all right until yesterday. She lost her water and won't catch. There is plenty of water in the well; only 10 feet lift; pipes all right and nothing wrong with the pump, for we had her all apart, only she won't pump."

"Can you start her up?" I asked. He gave the throttle a turn, and that pump just gave two or three shivers and then started off like a pneumatic calking tool, making about 4,000 1-inch strokes a minute, and was just beginning to walk off the foundation when I got her stopped. I walked around that pump twice; partly because I didn't know what else to do. I couldn't make out what that rocker-arm arrangement hitched on to the valve stem was for. I found there was a thing on the piston rod which seemed to be to knock that rocker arm first one way and then the other. I had the engineer start it very slowly; but it only gave little convulsive jerks, as though its life as a pump was about at an end. I never knew just what inspired me to do it, but I put two fingers on that rocker arm, possibly to see if I could get them cut off, when suddenly that pump started off in the most well-behaved manner possible, and it continued to run so as long as my fingers remained there; but as soon as I removed them it took another fit. I finally got it into my head that that rocker arm worked too easily, and I discovered that the stud on which it was pivoted had a special spring washer under the nut for the purpose of making sufficient friction to keep the arm in one position until the pump made a complete stroke and knocked it back again. A half-turn on the nut made that pump all right. I think now that the other fellow must have been awfully stupid; still, subsequent experience has proved to me that there are others.

The duplex pumps have displaced many of the former annoying and complicated valve gears, with auxiliary pistons, which in turn were operated by auxiliary valves with ports drilled in them which looked to a casual observer like stray blow-holes of no particular importance—at least that is what I thought they were when I first saw them. It was at a big brick works two miles out. They telephoned in just about quitting time to have someone come right away to fix a pump, as they couldn't

get water in the boiler, etc. I got there when I ought to have been sitting down to supper, and I was wondering what I had ever learned the trade for, anyhow. I knew the superintendent of the place; he was one of our customers, and none of us liked him. He tried to make us think he knew a whole lot, when he didn't know anything. He was leaving in a great hurry when I got there; said he had to meet a man. The engineer told me that he (the superintendent) had worked all the afternoon on that pump; had it apart three or four times, but could not make it go. If I had known that before I started I would at least have had my supper. It seemed as though that steam chest was carrying a young one on its back, and how it ever worked anyhow with so many blow-holes in it was a mystery to me; but presently I got it through my head that the holes were there for a purpose, and following this clue I worked out the theory that the little valve had to move first and let the steam get through those holes to the piston on the big valve, and when the big valve moved it let steam into the pump cylinder. I found the little valve had got turned around so that the little holes didn't match. I took it out and put it back the right way, and although the engineer watched me closely, I had the pump running before he knew what I had done, and I wouldn't tell him. I was hungry, and when that superintendent afterwards tried to find out, I wouldn't tell him either. But we charged him enough to pay for that supper, all right.

There is one steam pump on the market which has a port cut in the gasket under the cylinder head. The space between the port and the bore is a narrow strip which sometimes blows out, and I have known two or three cases where all hands were stuck because they did not discover this.

A prominent mechanical engineer told me this story: "Several years ago I went to look after some work in a new powerhouse. On arrival I found the plant stopped on account of a pump which refused to work, although an 'expert' had been there and gone away disgusted. They entreated me to see whether I could fix that pump, but, as it had nothing to do with my work, I turned a deaf ear to their entreaties and went on with my own task. I had never had much experience with pumps, anyway, and I thought I had better keep out of it. But when they all went over to the hotel for supper I stayed behind a few minutes to take a look at it. I took off the cylinder head and found on the gasket the impression of a small port which had not been cut open. I stabbed my knife in it, put the head on again, and the pump went all right. I left it running and got up to the hotel only about fifteen minutes after the others, without their even missing me. After supper they were still berating the pump, and when I told them that it was running all right, they would not believe me, until I took them back and showed it to them."

I will close this with a rather amusing incident a friend told me some time ago. He said: "I was working in a shop in Philadelphia some years ago, when I was told to go to a brewery some thirty miles out to fix a pump. I got there in the evening, and was much surprised to find a pulsometer. I had never seen or heard of one before. I also found that two other men from different shops had been there and couldn't make it pump. My prospects were not very bright, but I got my supper and tackled it. There was plenty of water in the well and the piping was all right, so the trouble must be in that queer-shaped thing they called a pump. I took it apart, and there was nothing in it but a little ball in the top and four valves in the bottom, and they were all right. I tried it again, but it wouldn't work. There was nothing in the pump to fix but those valves, so I took them out, one at a time, looked at them, put them in again and tried that pump. I kept doing that all night long, and although it was not warm, I sweat from sheer exasperation. For some reason along toward morning it took a notion to pump. I don't know why, but it pumped.

"I got my breakfast, and when I came back up over the hill I drew a great sigh of relief to see that the water was still pouring out of the pipe on the top of the tank. The proprietor greeted me very cordially. 'Oh,' he said, 'you is a fine mechanic. We had two men here and they not could fix dot pump. How much I owes you?' I charged him for time and expenses, and added $10 for knowing how. I don't know yet what I did to that pump, but we got all his work after that."

Brazing Cast Iron.

The reason that cast iron cannot be brazed with spelter as wrought iron can, is that the graphitic carbon in the former prevents the adhesion of the spelter, as a layer of dust prevents the adhesion of cement to stone or brick. A process to remove this graphite has been patented in Germany, consisting essentially in applying to the surfaces to be united an oxide of copper and protecting them against the influence of the air with borax or silicate of soda. When the joint is heated the oxide of copper gives up its oxygen to the graphite, converting it into carbonic oxide gas, which escapes in bubbles, while particles of metallic copper are deposited on the iron. Any oxide of iron which may be formed is dissolved by the borax, and the surfaces of the iron, thus freed from graphite, unite readily with the spelter which is run into the joint before it cools, the copper already deposited on the iron assisting the process. The inventor claims that cast iron can in this way be readily brazed in an ordinary blacksmith's forge.

A Combination Tool for the Turret Lathe.

BY D. E. MACCARTHY.

The tool shown in Figs. 1 and 2 is designed something after the style of the regular cross-slide tool, with some new and useful features added. The body and shank *A* are made of a one-piece steel casting, the shank finished to fit close in the turret head. The body is milled or planed the entire width to receive the cross-slide blocks or tool holders, which last are made in one long piece for convenience and afterward cut in two and fitted up to allow them to be worked independently of each other. The front or center ends of the slide blocks *B* and *C* are cut down to receive a connecting piece of steel, which when in place makes the two blocks work as one, also serving another purpose as a tool holder for special operations.

The tool-slide blocks *B* and *C* are each arranged with rack and pinions, of 20 pitch, the rack being cut in the lower back edge of the blocks well shielded from chips or dirt. Two pinions and shafts are provided, so that one tool may be worked, while the other remains in some permanent position as required. The usual stop screws with two check nuts as commonly used on cross-slide tools are efficiently replaced by the two clamp bolts *E* and *F*, which are fitted to slide free in the long slot *D* cut in the bottom of the tool body, the bolt heads entering slots in the slide blocks which are cut only a short distance into the block forming a stop at the end of the slot.

Fig. 3 is an end and top view of the steel connecting piece with the special cutter *a* attached. This tool is for finishing both side faces and chamfering both edges of the hole in cast brass nuts, as shown in Fig. 4, all at one operation of the slide tool. The nuts are made in various sizes from 1¾ inches, 12-thread hole, to 3 inches, with about the same area of bearing surface from the edge of the hole to the flat of the hexagon, and are used for making electrical connections on switchboard work requiring a nice fit on the thread, and both sides exactly parallel and square with the thread. The little tool with the double cut and double chamfer does the work cheaply and well, allowing the nut to be finished complete at one setting. The nut is held in jaws fitted to the standard two-jaw turret lathe chuck (see Fig. 5). A slot is cut in the jaws to give clearance for the front wing of the double-facing tool.

Another special cutter is shown in Fig. 6, used for finishing the rim of the cast brass hand wheel, Fig. 7. One side of the tool is used for a roughing cut, the other for finishing. The life of these two special cutters is limited to a few operations of re-grinding, but they have been found very efficient and economical, owing to the small cost of making them in lots of half a dozen or more.

Letters from Practical Men

King Solomon's Foundrymen.

Editor American Machinist:

Every person conversant with foundry matters will admit that the largest and heaviest castings are generally made around the old foundry stove or on the street corners. Some time ago I was an interested observer of a trainload of castings, consisting of gun carriages for the large disappearing guns for the Sandy Hook fortifications, and while examining them an old timer (and an old winder as well) came along, and after a few remarks on the castings he began to relate the old story of some large castings "he had helped to make" on the other side, and from his description of them they must have been heavier than the famous rock of ages.

In thinking over some large castings of which I had read or had seen, it occurred to me that there were castings made many, many years ago that would be very interesting jobs to-day, notwithstanding all of our modern improvements and advanced foundry practice. We will take for example the two columns that were placed in the porch of King Solomon's temple. These columns were 27 feet high, 6 feet in diameter, 4 inches in thickness, and weighed something like 44 tons each. These columns were of cast brass, which makes the job still more of a wonder, and leads us to think that there were some who worked in those days that could have given us a pointer or two in the great art of founding.

We will suppose of course that these columns were cast in loam, as we read they were cast in the clay ground on the banks of the river Jordan, between Succoth and Zarthan, which must have been quite a smelting center, as we read that King Solomon ordered all the vessels of the temple to be cast there, and which were quite numerous.

A column 27 feet high, 6 feet in diameter, is a mammoth casting. To make this casting to-day we would require lifting plates, rings, binders, sweep, thousands of bricks, fire sand, core ovens, cranes, etc., etc. Did those ancient craftsmen have all these modern appliances at that time? Our ancient craftsmen, under the control of Hiram of Tyre as manager, must have had a hot old time getting those columns cast. Let us for a moment allow our imagination to wander back through the centuries that have intervened since the erection of that famous temple on Mount Moriah, and see those workmen on the banks of that river building brick upon brick until the huge mold was completed. How did they manage to dry the mold (as we can hardly suppose it was sun dried)? How did they manage to put this mold together when it was finished and dried? All these things provoke thought, and some most expert in foundry practice to-day will have to concede that King Solomon's foundry boss was a long-headed one.

Let us imagine those men closing their mold, binding it together, ramming up the pit, building their reservoir and runners, and as the time approached to pour, we think we can see them running to and fro to see that everything is O. K.; everyone trying to do his best, because they were casting a column for the most magnificent structure the world was ever to see. And at last, when all was ready and the Old Man cried, "Let her go," "Light those vents," "Watch those risers," "Hoist," "Up!" "Whoa," and the work of months was cast, how did they manage to get this immense body of metal out of the pit and

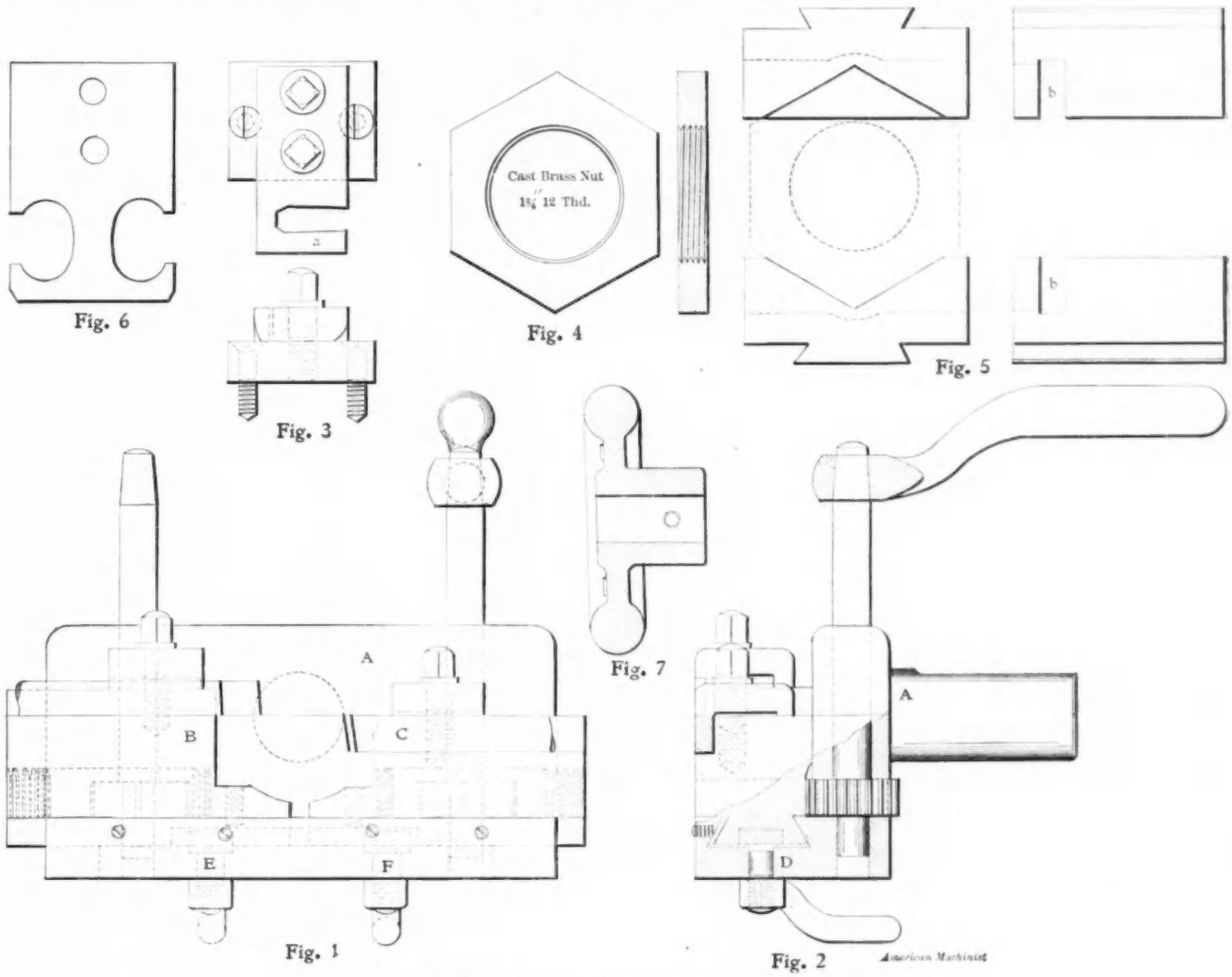


Fig. 6 Fig. 3 Fig. 4 Fig. 5 Fig. 7 Fig. 1 Fig. 2

A COMBINATION TOOL FOR THE TURRET LATHE.

get it to its final resting place in the porch of Solomon's Temple? This achievement gives our engineers of to-day, with all their modern appliances, something to think about. How did those ancients overcome all the obstacles that certainly presented themselves while the work was progressing?

We are also informed that these columns were of cast brass; this leads us to believe that they knew something of the art of making alloys; and if their compositions and alloys were as remarkable as their other work, we can have no doubt that they would bring a very good price to-day. F. B. SHAFFER.

Elizabeth, N. J.

A Knife-Edge Square.

Editor American Machinist:

While the purpose of this article is to describe how a fine square can be made and used, it may not be amiss to say that probably in no other line of manufacture

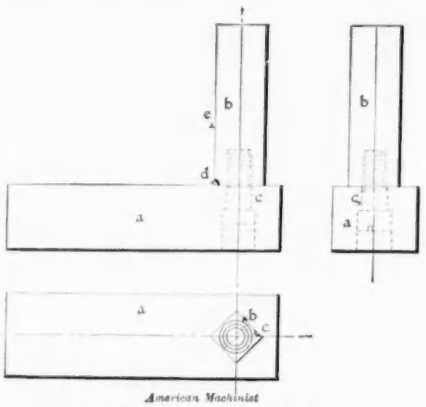


FIG. 1. KNIFE-EDGE SQUARE.

has the interchangeable system been applied for so long a time or brought to as high a state of perfection as in the casting of type for printing. This does not mean only that the type of any one foundry will interchange, but that those of one foundry will interchange with those of any other. The difficulty of maintaining an absolute interchangeability and its practical necessity will be readily understood if we take a column of the "American Machinist" as an illustration. If the body of each type in a line was just .0001 inch out of square on its lower side we would have a curved line; if some were out of square at the top, others at the bottom, and still others were square, we would have a zigzag line. As each type body must bear firmly against its neighbors when locked in the form, we would have a column of dancing letters that would drive a reader to distraction.

The sketches represent a square largely used in making the parts of the molds (which are themselves interchangeable and are used on automatic machines), its "precision block" and a lapping plate.

In Fig. 1 the beam *a* and the blade *b* are held together by screw *c*, as shown.

Fig. 2 is a rectangular prism, in which the sides *a* and *b* are lapped parallel and end *c* perpendicular to them. Necessarily, if *c* is square with either side it must be so with the other. All parts should be made from machine steel, deeply case-hardened and allowed to thoroughly "work" before finishing, but will require frequent correction as long as used. On account of its extreme sensitiveness the square is worthless without a block with which to test and correct it. The block is corrected by micrometer and it's square.

In Fig. 1 the space *d* is left to catch dust and ravelings of cloth that would interfere if the corner were left sharp.

Figs. 3 and 4 show a lapping plate which consists of a cast-iron plate having a rectangular recess filled with lead or babbitt metal, carefully planed and charged with flour of emery by means of cast-iron stick and water. There should be a pair of these (for roughing and finishing) and care must be taken to so use them that the wear is about uniform at all parts of the surface. When the lead is poured the casting should first be made very hot to contract with the lead in cooling.

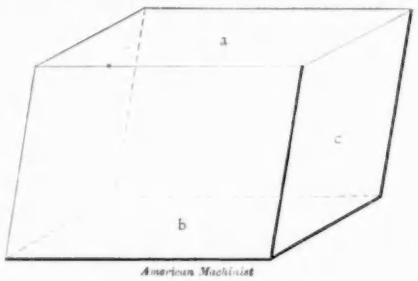
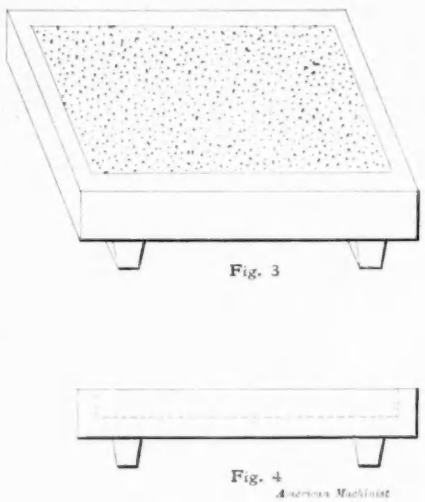


FIG. 2. TESTING BLOCK.

Figs. 5 and 6 show the method of testing the square and block, also how the square must be held in different positions on account of the impossibility of holding it so that diagonally opposite corners of the blade will be perpendicular to the surface with which it is in contact; the corner of the blade at *e* being slightly rounded for the purpose.



LAPPING PLATE.

In making the square the beam and blade are hardened, ground and lapped; the beam on one side, the blade on two adjoining sides and the screw end.

As it is impossible to lap the end of the blade perfectly square, the corner *e* is honed after assembling until it is square, and afterward corrected in the same manner, as needed. The square should never be taken apart for that purpose.

The length of the beam is usually about 2¾ inches, and of the blade 1¾ inches. The block is slightly larger than the square. Lapping plate is about 10x14 inches.

With practice, an error of .0001 inch can be easily detected, and in the work for which they are used the limit of error is slightly less. A. B. CHRISTMAN.

Why the Engine Wouldn't Work.

Editor American Machinist:

I think it's a shame the way our correspondents are jumping on Osborne about that engine. In issue No. 6 someone wanted to know about the weights, and now, No. 7, Mr. Willis wants to know about the two firemen and the dry lumber. Why, it's as plain as the nose on a face, and it is surprising that these hypercritical gentlemen fail to see it. The engineer had piled those weights on the steam to hold down the pressure, and as they were insufficient to keep it down, the two firemen piled the dry lumber on it. The dry lumber had another good quality to make up for its lightness; being dry, it was porous, and absorbed the surplus steam, and so helped to keep down the pressure and make it agree with the defective gage. With such a load the pressure was sure to be held down safely. Now this explanation is as clear as mud, and I hope it will clear Osborne's good name and enable him to continue giving us the benefit of his experience in a part of the country where the people do lots of queer things.

L. O. DANSE.

A Tool Room Check System.

Editor American Machinist:

The accompanying picture is a photograph of a portion of the toolroom of

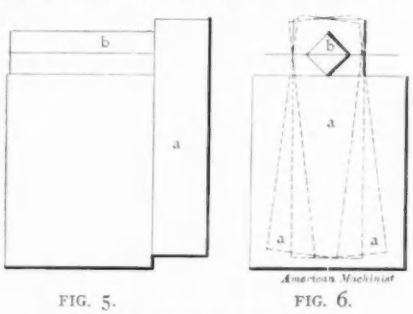


FIG. 5. FIG. 6.

METHOD OF TESTING SQUARE.

Fairbanks Scale Works. At the left of the picture will be noticed a frame containing about a hundred names on card-

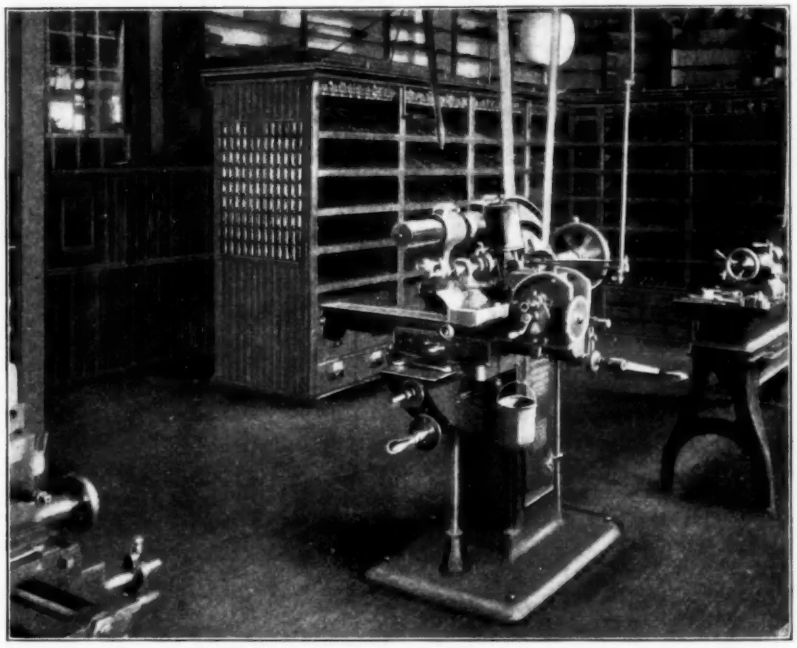


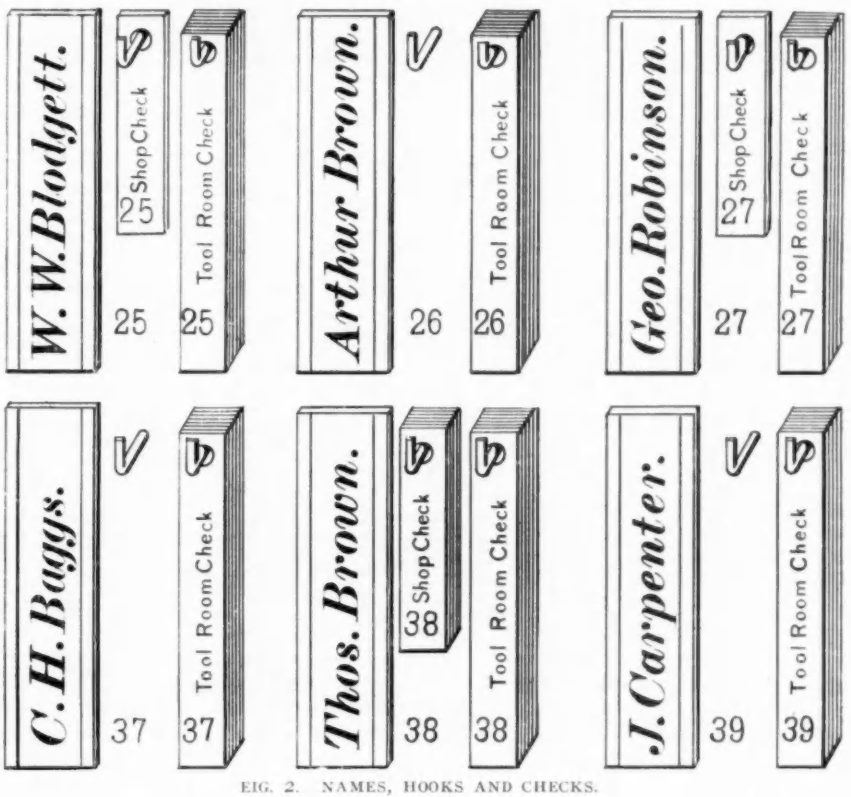
FIG. 1. FAIRBANKS SCALE WORKS TOOLROOM.

board, each enclosed in a brass clip, so that it may be withdrawn and others substituted if desired. The system consists in assigning a number to each workman and giving him a dozen brass checks, each bearing that number. In the toolroom are also kept, for each man, a dozen other checks bearing the same number, but the checks are of a different size and shape from the first.

Near each name on the board are two hooks—one originally empty, the other containing the dozen toolroom checks. When a workman calls for a tool he presents his check, which is hung up on the empty hook, and one of the large toolroom checks is removed and hung on the shelf in place of the tool. When the same workman wishes another tool, the same process is repeated, until all of his checks are used up.

An inspection of the board at any time will show how many tools each man has out, by the number of workman's checks which have been turned in. On Saturday nights the tools are all called in, and the workmen's checks all returned. This is done to prevent negligence in returning tools; but if for any reason a workman wishes to retain any tools for a longer time, he may obtain permission from some of the foremen. By this "scoring up once a week it is found that neither the tools nor the checks are so liable to be lost or mislaid as when they are allowed to be out for an indefinite length of time.

W. H. SARGENT.



EIG. 2. NAMES, HOOKS AND CHECKS.

Boring a Shaft.

Editor American Machinist:

The article in your issue No. 49 of last year, by Mr. Porter, of the Bethlehem Steel Company, on "Hollow Shafts," calls to mind a case that came under my observation not so very long ago. I was at the time in the employ of a company that builds very heavy electrical machinery, and an order came in that called for a 6-inch hole through a shaft about 10 feet long. There was considerable discussion as to the best way to get that hole put through, and finally the foreman of the die job (who, by the way, served his time at the Krupp Works) was called in to express his views on the subject. "Vell," he said, "I could fix dot right avay." He had done such work on the other side; so he outlined a plan for boring that hole in quick order. Then arose another suggestion by the superintendent (who happens to be of the same nationality) as to the possibility of cutting a core out, thus saving a 4-inch shaft for the company. Well, that could be done, but of course they would have to make special tools for it, and from that time on the saving of that 4-inch core became the all-absorbing feature of the process.

The foreman of the die job was given orders to make the tools that would be required. He made a steel cylinder about 6 inches long, with a 4⅛-inch bore and 5⅞ inches outside. One end was threaded for a piece of boiler tubing to screw in up to a shoulder, thus leaving a 4-inch hole through the entire structure. The head was then removed from the piece of tubing and three cutters were set into the other end, thus producing a hollow mill on rather a large scale. The cutters were made of three different widths, the narrowest one being set about 1-32 inch in advance of the one following, and so on, the last one the full width of the cut. They were well backed off for clearance. On the base of each cutter was left about ½-inch space of the full width to grind. The cutters were then hardened and set and the head was put into the universal grinder, and the bases of the cutters were ground inside and out, thus giving the tool a three-point contact when working at its full capacity. The head was fitted on to the tubing, a cap was fitted to the other end, and a hole was drilled and a connection put in for a rubber hose. The

tool was then mounted on the carriage of a large lathe and connections made to force water through the tube, thus washing the chips away from the inside of the tool. After a great deal of trouble, and wear on the nerves of some of the officers, they managed to get a hole through that shaft, but I don't think the job will ever be repeated. BARLOW.

Odd Jobs in the Pattern Shop—Band Sawing to Save Turning—A Jig for Pasting Cores—A Roller to Stop Chattering.

Editor American Machinist:

Here are notes of several jobs out of the ordinary that a patternmaker so often gets:

A ring, 8 feet diameter and 12 inches deep, came in to be turned. On measuring it to see how much was left for turning, I found ⅜ inch to come off the outside, and 1½ inches out of the inside. To save some of this inside turning, a circle was struck on the ring ⅜ inch less than the finished diameter. Then by putting the entire ring over the band-saw (belts not interfering), so that the machine was inside the ring, the superfluous stock was sawed out in far less time than it could have been turned out.

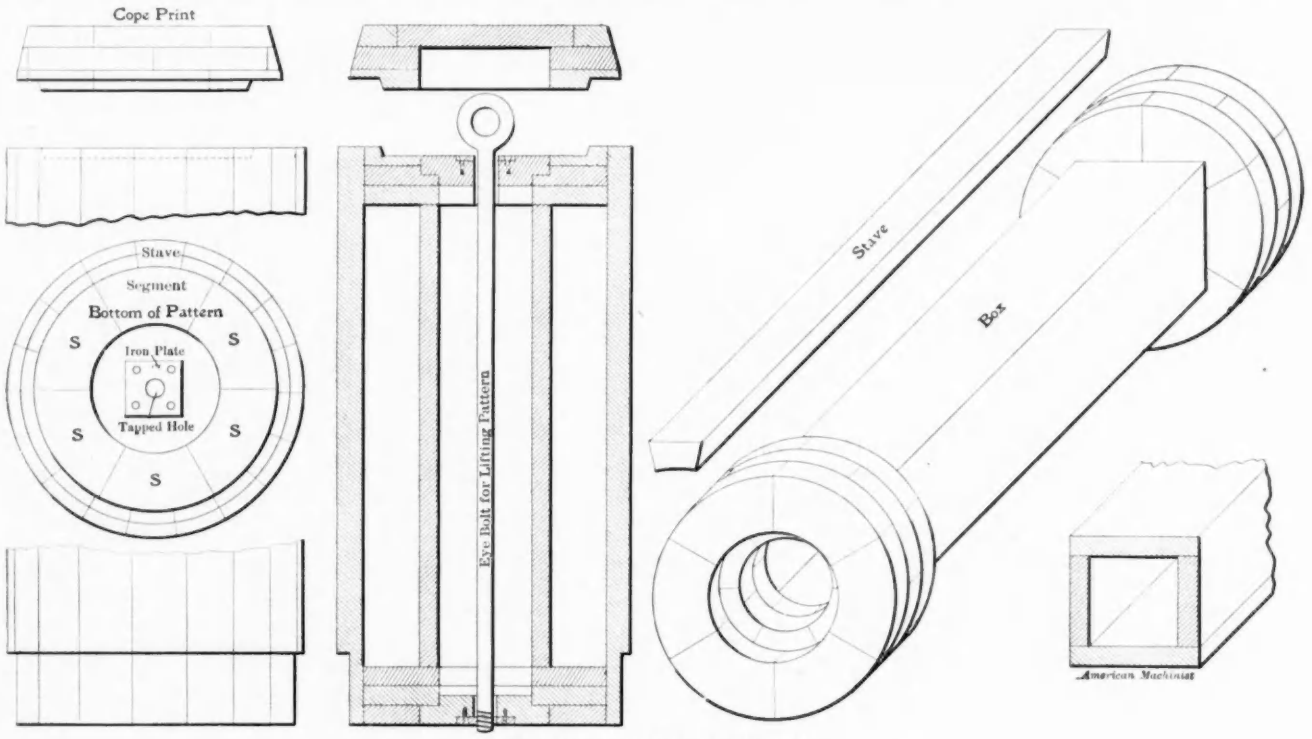
. . . . . .

We had a cylinder to make having several cores that required to be pasted together just right. To get this result, a wood jig was made having a rest on it for at least two points of each separate core, and necessary stops. The cores were pasted together in the jig after being dried, and the paste was allowed to set before being handled. This left nothing for the coremaker to measure or use his eye on. For larger quantities a cast-iron jig would have been the thing.

. . . . . .

In turning a ring of 38 inches diameter, of irregular outline, to finish ¼ inch thick, chattering made a smooth job impossible. The problem of how to stop the chattering was solved as follows: A hardwood roll, 4 inches diameter, ½-inch face, with hubs 1 inch long, was turned true on a short piece of ½-inch shaft. This was then mounted in hardwood frame, with the shaft running in the frame. Heavy grease used in the bearings prevented heating. The frame was adjusted and suitably clamped, so that the roll would bear on a carefully turned portion of the ring. By turning off the ring so that the tool would push it against the roll, the chattering was cured. By changing the roll to different points as the turning progressed, a good job was secured in less time than could have been done without it, even allowing for the time used in making the roll.

J. L. GARD.



PATTERN FOR A CYLINDER LINING.

A Pattern for a Cylinder Lining.

Editor American Machinist:

The enclosed sketches of a standard pattern for a brass lining 16 inches outside, 14½ inches inside and 28 inches long illustrates some novel features in pattern construction. The ends are built of three courses of segments and are turned out to receive the center pieces, which are turned from a solid piece of stock. A square box with open ends, to which the ends of the pattern are glued and screwed, brings the foundation for the finished pattern to the required length, with an allowance for truing up the ends in the lathe. Next the center pieces are fastened in place, and the whole structure is centered in the lathe and the segment ends are trued up to the right diameter.

The staves are concaved on the circular saw to fit the segment ends, to which they are glued and screwed. The method of concaving with a circular saw has been described one or more times in almost every volume of the "American Machinist," and as the accompanying sketches explain fully the method of constructing this pattern, I will waste no more valuable space by going into details. Whether it is the best way to make a pattern of this description, I can't say, but it represents first-class practice in at least one modern shop. "HOBO."

The Use of Indicators for Testing Work.

Editor American Machinist:

In Fig. 1 is shown a method for determining, by the use of an indicator, the variations in the diameter of numbers of round pieces, or at various points, longitudinally or circumferentially, of a single piece, or between a number of pieces of unknown diameter and one of a known or standard diameter. An indicator is fixed upon a plane surface *B*, and the piece to be tested *A* is rolled back and forth beneath it, and by contact with the shoe of the indicator spindle it causes the pointer to traverse the graduated circle, pieces of larger or smaller diameter causing it to travel a greater or lesser distance, respectively. This rig is also useful for com-

paring two or more portions of a flat or square surface or a number of pieces. When testing a number of round pieces, the small collar at the upper end of the spindle is adjusted vertically, so as to allow the lowest part of the shoe to hang slightly lower than when *A* is in contact; otherwise it would be necessary to raise the spindle each time work was to be inserted. The chief advantages of this arrangement are its rapidity and also its reliability; so that different persons are more likely to get similar results than by using micrometers, the results from which are governed by variations in instruments, body heat and personal temperaments.

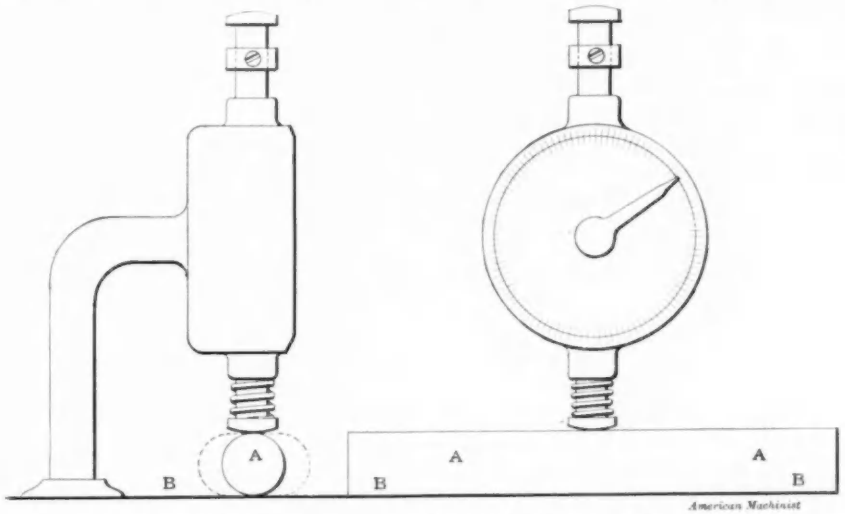


FIG. 1. USE OF THE INDICATOR FOR TESTING DIAMETER OR THICKNESS.

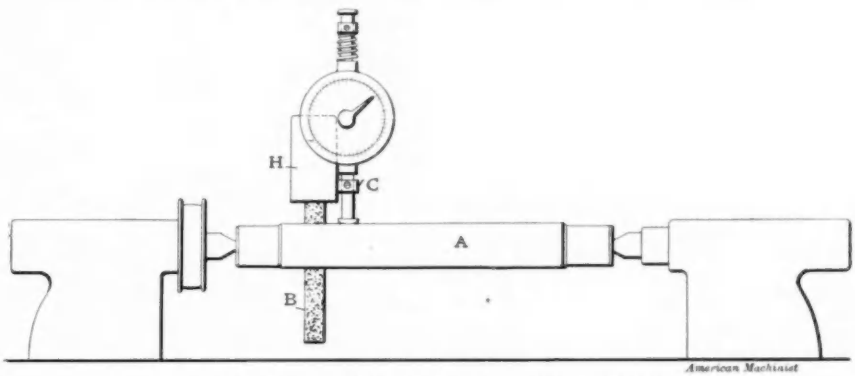


FIG. 2. THE INDICATOR ON THE GRINDING MACHINE.

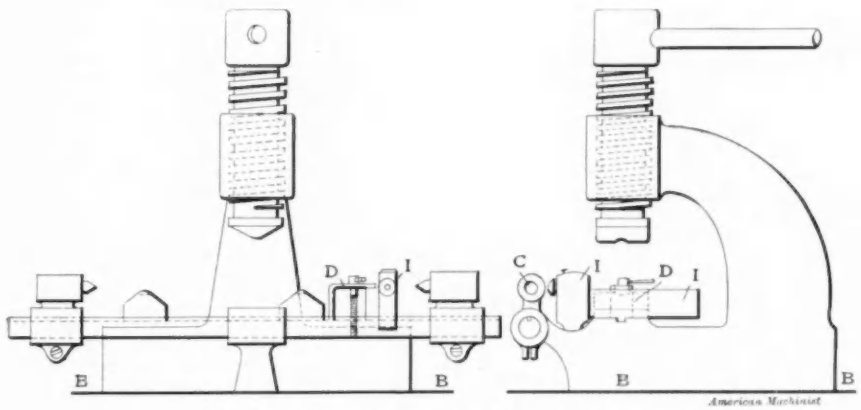


FIG. 3. THE INDICATOR ON THE STRAIGHTENING PRESS.

In Fig. 2 is shown a method of setting a grinding machine to grind straight or to a desired taper in thousandths of an inch for any portion of or the entire length of work without stopping the machine. By depressing the indicator spindle until the shoe comes into contact with work *A*, variations in diameter, if any, are instantly shown. This can also be used to determine the diameter when a number of pieces are to be ground, and the operator can always instantly inform himself as to the amount of stock that is still to be removed; also, before beginning to grind, how much stock must necessarily be removed to make a piece round if it should not run true, or, in shop parlance, to "see if it will true up." *B* is the wheel, *H* the hood over the wheel, to which the indicator is affixed, and *P* the swiveling plate carrying head- and tail-stocks.

In Fig. 3 is shown a straightening press with centers, attached to which is an indicator *I* secured by an L-clamp *D*. Where this device was employed, as a great deal of the work to be ground was turned on screw machines and centered afterwards, with an allowance of only .003 to .005 inch for grinding, and as the grinder operators often found it impossible to judge before beginning to grind whether pieces ran true enough to grind out all around, it was necessary to have some means by which this point could be quickly determined. The center stocks, supporting the blocks and bar, can be moved independently, and the center stocks can, if desired, be both moved to the right or the left end of the bar, so that any portion of any piece can be tested. The addition of the indicator to the press does not decrease its efficiency as a straightening press, but rather increases it.

A. B. CHRISTMAN.

Why Another Engine Wouldn't Work.

Editor American Machinist:

Mr. Osborne's letter, on the first page of your first issue of the century, as to "Why the Mill Engine Didn't Work," recalls to my mind another mill engine that, some ten years ago, refused to work. It was a 500 horse-power, built by a well-known Western builder, and specially designed for sawmills. At that time it was about twelve years old, and had been running quite constantly, and was consequently worn and a little shaky; so its engineer, who was also superintendent of the mill, decided to shut down and have it thoroughly overhauled.

Well, its cylinder was rebored, new rings were made, the piston rod was turned off and new boxes made for the crank shaft bearings, and then upon me devolved the job of setting and lining up; so when that part of my job was accomplished I had steam raised in one of the five boilers, and gave the engine a, to me, highly satisfactory test.

Imagine my surprise, disgust and discomfiture when, a week later, the engineer-superintendent came marching into the shop and curtly informed me that "that infernal engine was worse off than ever it was." After a week's trying to make it run he had come to the conclusion that it couldn't drive a coffee grinder, and if I didn't get it going in twenty-four hours he'd hold our company liable, etc., etc.

Well, upon arriving at the mill I went through just about the same stunts Mr. Osborne describes and reached the same results as on my former test; but in vain. I tried to explain to my engineer-superintendent that the engine was O. K., but he

claimed the steam blew right through; and then he attempted to prove it. He had the fireman bring up the pressure to 120 pounds, the blowing-off point; started two 60-inch circular saws and advised me to watch her performance; and, sure enough, she commenced to slow down from seventy turns a minute to what I guessed to be about forty. I ran out into the fireroom and the gages showed the pressure at 60, and the hands were still moving backwards.

Now, here was something I could not see through; five 120 horse-power boilers going at full blast, and the pressure from 120 pounds to 60 in ten minutes. There certainly was something wrong; so once more I went through my stunts with that engine; and it made me sweat. Then I went to the fireman and asked him about the boilers, to be met with the reply that they were the easiest steaming boilers he had ever seen, and only lately did he have any trouble in keeping steam up; but then her valves leaked, the rings were bad, etc., etc.; but since I had fixed her—well, I had seen for myself. She simply ate the steam now, and she was getting worse every day. In fact, since the engineer had tried to start up he had poured oil on the shavings and sawdust, in hopes that with them for fuel he could keep up the pressure; but to no purpose. He had had all he wanted of it, and would not try any more.

Well, I was getting desperate, and, knowing of nothing else to blame, I insisted it was the fault of the boilers; said they needed cleaning, as they were probably all scaled up inside. So the fires were pulled and the boilers were blown down, and when sufficiently cold I had a look into them. It was discouraging, for they were not at all bad; so, sitting on a box in the fireroom, thinking it all over, I happened to notice the peculiar smoke-stack connections. The stack was built into a corner of the boiler-house, and a long square box of boiler iron carried the smoke into the stack. From the boilers to the stack there was a rise of about 3 feet, and, looking around for some way of getting a look into the thing, I was amazed to find none, and on asking the fireman about it he told me that the only way was through the stack or the smoke-boxes.

Instinctively I knew I'd found the trouble, and, after getting myself as black as coal, I was able to inform our engineer-superintendent if he'd have it cleaned out we'd have another try. As there were only eight barrels of soot in this box, and almost all the thing was choked except the last boiler, which was near the stack, you can easily see why the steam blew through. Of course the boilers were all connected together, so the pressure was even in all, but the one near the stack did all the work, and then only at half its capacity on account of our engineer-superintendent's patent natural damper (now automatic), and the fireman's efforts with oil and shavings had only aggravated the thing.

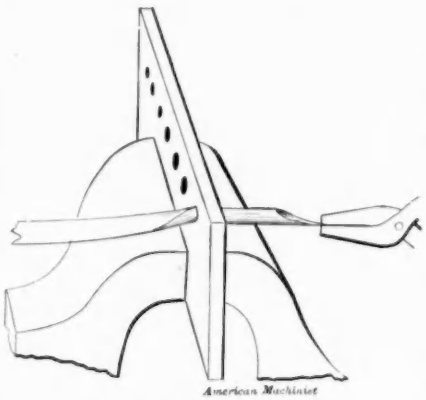
Since then I have had a sneaking idea that the engine needed no overhauling in the first place; but, then, the engineer-superintendent said it wanted it, and he was infallible, don't you know.

L. O. WEYER.

A Tube Drawing Kink.

Editor American Machinist:

I take the liberty of sending you the following kink on home-made tubing, which no doubt will be of profit to those of



MAKING SMALL TUBING.

your readers who are engaged in model or experimental work, as well as of interest to many others who may have the idea, as I myself had, that to make even small tubing required expensive special machinery. Of course this method to be described does not produce seamless or even air-tight tubing, but nevertheless it will be found very useful for many purposes, as it is practically oil-tight.

Take a piece of tool steel about 5-16 inch thick, 2 inches wide and 4 or 5 inches long. Drill some small holes through it, ranging from about 1-16 to ¼ inch, according to the size tubing you wish to make. Polish out these holes nicely, round their corners on one side and then harden the plate. Next cut the sheet brass or copper (which, of course, should be soft) into strips 3 or 4 feet long and of a width which is found by a little experimenting to be best, this not being nearly as imperative as would be supposed. Point the ends of these strips so that they will easily pass through the plate far enough to be tightly gripped by pliers. Now with the plate held in a vise and the strips well greased, pull them through as seen in the sketch, and you will be delighted to see the perfection attained by so simple a "dodge."

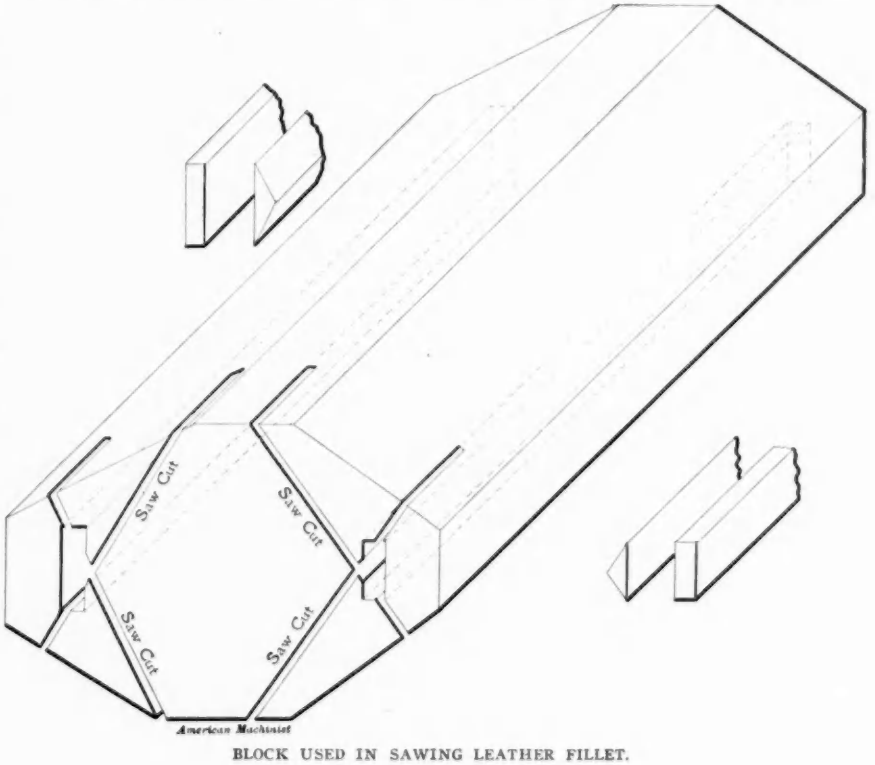
D. H. N.

Rig for Sawing Leather Fillet.

Editor American Machinist:

This odd-shaped block of wood, with two rectangular holes through it, is for making leather fillet on the band saw. The leather is cut to slip through the rectangular hole, the block being clamped on the saw table. The sawing is done with the opposite angled faces of the block resting alternately on the saw table, the saw running into end of block about ¾ inch. The block shown is for making two sizes of fillet; the leather strip is passed through the square hole twice for each length cut, one bevel face being cut at each pass. With a good band saw and ordinary care, a very good fillet can be made with this little device.

HOBO.



BLOCK USED IN SAWING LEATHER FILLET.

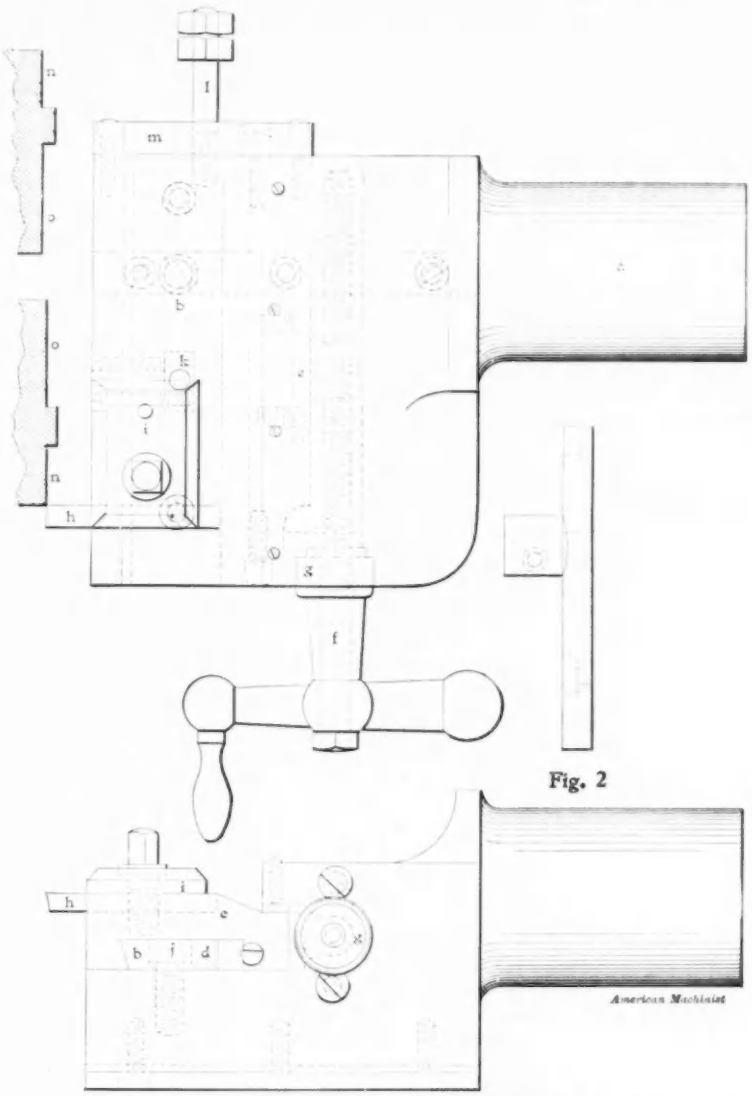


Fig. 2

FIG. 1. BOX TOOLS FOR HEAVY TURRET WORK.

Heavy Box Tools for Heavy Work.

Editor American Machinist:

I have never seen illustrated or described in the "American Machinist" box tools that would be suitable for heavy cast-iron work on a turret lathe. I send you drawings of some that were recently designed and put in operation for facing the bases of the Foby gas meter, but which could be adapted to a variety of work.

The tool, Fig. 1, consists of the casting *a*, the shank of which is carefully turned to fit the turret and the ends faced off in the lathe. The body of the tool is then planed all over to the proper sizes. The slide *b* of tool steel is screwed in place as shown, and the rest *c*, Fig. 2, also of tool steel and which is provided with a taper gib *d* (tapering 1-16 in 6 inches for adjustment for wear) fitted to it. The nut *e* is dovetailed into the rest, the casting bored to receive the screw *f*, which is adjusted and held in place by the cap *g*, which is fitted to the counterbored casting and is forced against the collar by the two small screws, the collar having a bearing on the bottom of the counterbore. The rest is slotted to receive the cutting tool *h*, preferably of self-hardening steel, which is held in position by the cap *i* and the screw.

The holes in the slide *b* are slightly elongated to allow it to swivel on the large screw *j* to compensate for any lack of alinement of the machine.

The method of adjustment is shown at *k*, where the casting is slotted to loosely receive the lug on the bottom of the slide, shown in detail at the right. A 5-16 hole is drilled in the slide in the proper position; the slide is then placed in the milling machine and a small diameter cutter dropped down in the center, after the style of the Woodruff system of keying. A piece of 5-16x¾ steel is then turned on one end and also to fit the circle or nearly so, driven into place and riveted, the object of the circle being to prevent the piece from turning. A screw running freely in the casting and threaded in the lug pulls the slide to the left and one threaded in the casting forces it to the right. The tool *a* is shown in position preparatory to facing the meter base which is held on the face-plate by a special fixture. The stop *l* is screwed into the slide *b* and travels through a hole in the steel strip *m*, which is screwed fast to the rest *c*. It is obvious that when the screw *f* is turned to the right the rest carrying the cutting tool will travel forward facing the casting at *n n* until brought up against the check nuts on the stop.

After this operation the turret is re-

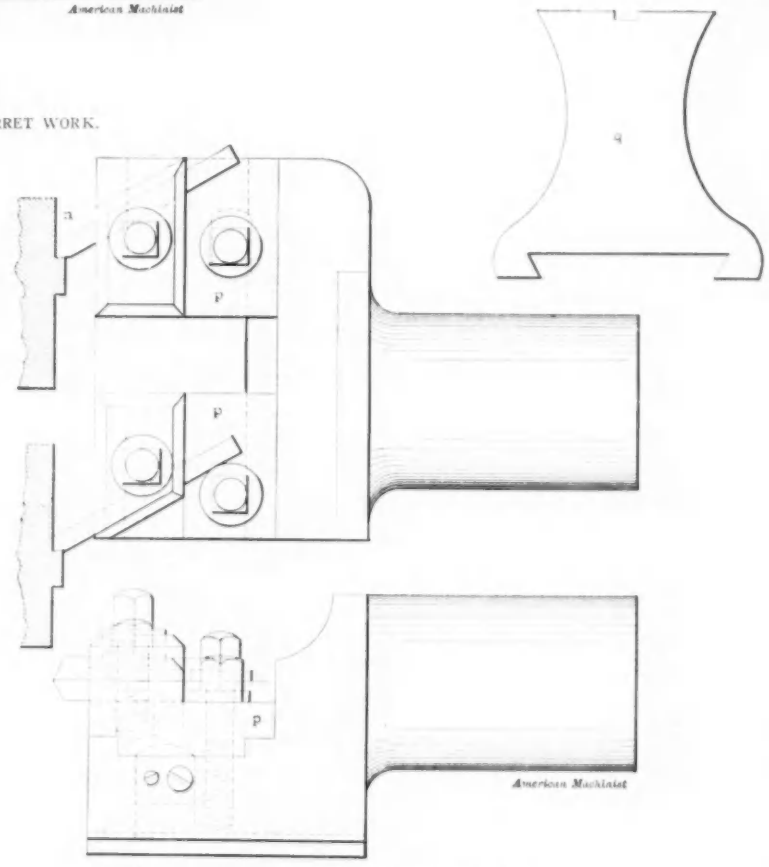


FIG. 3. BOX TOOLS FOR HEAVY TURRET WORK.

volved and tool No. 2 (of which no drawing is shown) is brought in position to face at *o o*.

Tool Fig. 2 is exactly the counterpart of the other, with the exception of the cutting tool, which is located in the rest *c* at nearly the center line, travels in the opposite direction and is set on the horizontal center, while the tool Fig. 1 is set 3-32 above. While the stop in tool Fig. 1 travels through the steel strip *m* and stops against the check nuts, in Fig. 2 the steel strip is threaded and provided with a set-screw, the point of which stops against the slide *b*.

After facing the base at *o o*, tool No. 3, Fig. 3, is brought in position and the shoulders squared. The casting of tool Fig. 3 is recessed as shown and the tool rests *p p* fitted to it with a slight lateral adjustment and held down by the screws. The screw holes through the tool rests are slightly elongated and the same method of adjustment is used that is used on the slide *b*.

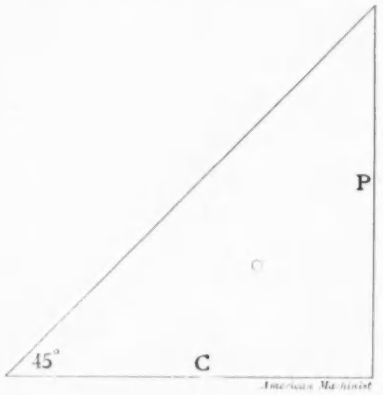
The bottoms of all the tools while working rest on a heavy cast-iron steady rest *q*, which is dovetailed to fit the bed of the screw machine. A hardened steel strip fits the slot in the top of the steady rest and takes the strain off the turret. Daily output, 100; with engine lathe, 20.

W. E. CALLAGHAN.

Measuring the Pitch of Screw Propellers—Getting the Factors.

Editor American Machinist:

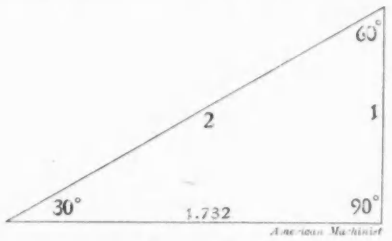
This is to describe the method of obtaining the factors used when measuring a screw propeller with triangles, as described



MEASURING THE PITCH OF A SCREW PROPELLER.

by me in your issue No. 6 of this year. As is well known, a helix is formed by winding a triangle about a cylinder. In Fig. 1 the base of the triangle *C* would be the circumference of the cylinder, and the hight *P* would be the pitch. If we used helices of different diameters but of the same pitch, *C* would vary with the diameter, while *P* would remain constant. When we measure a wheel at different diameters the pitch will remain constant (if the wheel is a true screw), but the circumference *C* will vary, and the triangles will therefore vary in shape.

When we place one of the small wooden triangles at the proper place on the blade it will be similar to the large triangle forming the helix whose diameter is equal

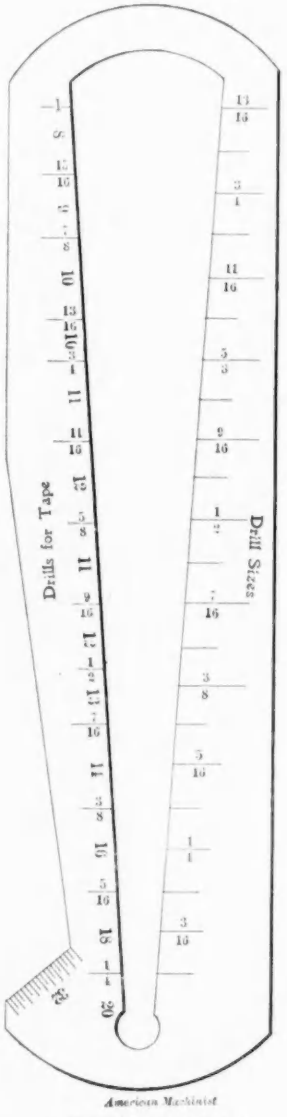


MEASURING THE PITCH OF A SCREW PROPELLER.

to that of the wheel at the point where the small triangle is applied, and whose pitch is equal to that of the wheel.

When we use the small 45-degree triangle we have the large similar triangle forming a helix whose diameter $= R \times 2$. When using the 45-degree triangle the formula therefore is:

$$R \times 6.2832 = P.$$



A TAP AND DRILL GAGE.

Assuming that Fig. 1 is the large 45-degree triangle, we know that

$$C = R \times 2 \times 3.1416.$$

Now, *C* and *P* are equal, so that

$$P = R \times 2 \times 3.1416,$$

or $$P = R \times 6.2832.$$

In Fig. 2, if the hypothenuse is 2 the hight will be 1 and the base will be 1.732. When we use the small 30 and 60-degree triangle, with the short side parallel with the face of the hub, we have a large similar triangle forming a helix whose diameter is $R \times 2$.

Now, $R \times 2 \times 3.1416 = C$, or the short side of the large triangle, and, according to Fig. 2, the long side, or $P = C \times 1.732$,

or $$\frac{P}{1.732} = C.$$

Hence $$R \times 2 \times 3.1416 = \frac{P}{1.732},$$

or $$R \times 2 \times 3.1416 \times 1.732 = P;$$

therefore $$R \times 10.8825 = P.$$

When we use the small 30 and 60-degree triangle with the long side parallel to the face of the hub, we have a large similar triangle forming a helix whose diameter is $R \times 2$.

Now, $R \times 2 \times 3.1416 = C$, or the long side of the large triangle, and according to Fig. 2, the short side, or *P*, will equal *C* divided by 1.732, or $P \times 1.732 = C$.

Hence $$R \times 2 \times 3.1416 = P \times 1.732,$$

or $$\frac{R \times 2 \times 3.1416}{1.732} = P;$$

therefore $$R \times 3.6277 = P.$$

G. S.

A Drill and Tap Gage.

Editor American Machinist:

I send herewith a sketch of a drill and tap gage. It gives on one side the actual measures, which can be used for measuring or selecting drills for any purpose. On the other side the marks indicate the sizes for tap drills to correspond with the tap diameters. The numbers of threads to the inch are marked under each size. The lip at the side forms a gage for grinding twist drills to the correct angle, here assumed to be 59 degrees. The graduations serve to get both lips the same length. There is still a lot of space to let on the other side of the gage; perhaps someone will suggest a use for it.

A. C. FRENCH.

Gardner, Mass.

How One Man Was Educated.

Editor American Machinist:

A few weeks since, you published the story of one who had gone from the shop to the university. It made me think that my story might be of interest to some of your readers. I was born and grew up in the vicinity of Philadelphia. My early education consisted in attending a country school for about two years. At fourteen years of age I began to learn the blacksmith's trade. At sixteen, when I began to work at a fire, I found that it gave

some smiths a great deal of trouble to understand a drawing. I was not yet working from drawings, but I made up my mind that when the time came for me to work from drawings I would know how to read them; so I went to a drawing school one winter. It was only two evenings a week, and two hours each evening, but it started me. At the end of the term I was advised to learn some arithmetic. I couldn't then add fractions, and thus I had lots of trouble in the shop; so I went to a public night school the next winter and learned how to do fractions and measure various forms, both plane and solid. The next winter I went back to the drawing school, as their course was supposed to cover two winters, and I never leave anything half done. (By the way, there was a machinist attending that evening school who is now a consulting engineer in Philadelphia and is a contributor to the "American Machinist" and other technical papers.)

By this time I had exhausted the night schools in that town, and, looking about for more worlds to conquer, I was advised to read a book on mechanics. I tried to, but was wrecked on the rock that wrecks so many aspiring mechanics—I mean such things as $\sin. 30°$, $\sqrt{a\,b}$, $d\,x$. We have all met them, and know just how unpleasant the meeting when we can't talk the language. I went to a machinist who knew a little of such things, and I was advised to study algebra and geometry. I tried them of course, but found the same trouble; I must have help to study them. Just at this time a night school was opened by private parties, where, for a nominal fee, instruction was given in algebra and geometry. For the next two winters I went there, and in that time I went through plane geometry and algebra through quadatic equations. At this time one of my acquaintances put it into my head to go to college. I did not care especially to go to college, as I thought that in order to do so would require the spending of a great deal of time on subjects that were far removed from mechanical things, and of so little utility that a man in my position would not be justified in attempting them. I was now informed for the first time about special students, and I at once saw how it was possible for me to get a technical education. I engaged a tutor and successively attacked trigonometry, higher algebra, solid geometry, conic sections, calculus, physics, chemistry and descriptive geometry. This was not done in a year. It took me seven years, and at twenty-eight years of age I entered one of the leading schools of mechanical engineering in this country prepared to study engineering. I stayed there two years, taking the engineering work of the course. Our technical schools only give two years of actual technical work, the other two years being merely preparatory to it. On leaving college I was for a year foreman in a smith shop, but as I thought there was too little chance there for utilizing a technical education I have changed over to the drafting room, where I am now intrusted with important work.

All the time that I was studying evenings I was also working days in a blacksmith shop. I was hindered by having to work overtime, by working night turns for eight months, by bad health, by being out of employment, by feeling it necessary to devote much of my savings to my parents instead of going to college earlier; but by always returning to the attack I finally succeeded. I might mention that I never had anything to do with correspondence schools. They seemed to me to promise too much; it was made to look too easy.

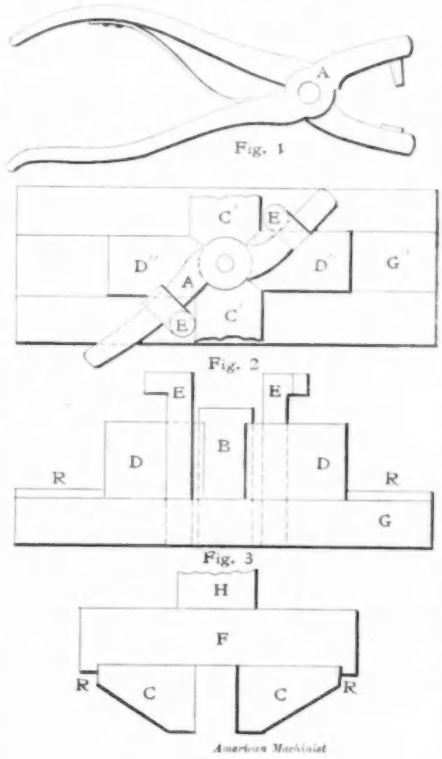


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

TRIMMING A JOINT.

Would I advise a young man to follow my example? That would depend on the man. Usually there is but one side of the case presented, and it is regarded as a wholly meritorious undertaking. I think it is not so. A man who undertakes to educate himself is very likely to develop more selfishness than one man should be burdened with. He must cut himself off from all social life; he is very apt to injure his health, which I have done, or to sacrifice an actuality for a possibility by devoting his energies to his studies instead of to his work, and thus taking a lower position in the shop. He must count on postponing his start in life for about ten years, and then start where the competition is as keen as it is anywhere. He is also very likely to postpone marrying for a matter of ten years, and that is a big hindrance to a man. If he is willing to accept all this, I say go ahead, but not otherwise. I might add in closing that from first to last I never received the slightest aid in any way from anyone, but paid every cent with money I earned at the anvil.

PERSEVERANCE.

Work on Cheap Hardware.

Editor American Machinist:

In the manufacture of the cheaper grades of hardware, malleable iron is largely used instead of steel castings or forgings. The low price at which the articles are sold will not allow any expensive work, such as milling, to be done on them. They are usually just drilled and put together. In the better grades of this class of hardware, such as belt punches, etc., making the joint at *A*, Fig. 1, is the principal expense, and the die shown in Figs. 2, 3 and 4 was designed to trim the joint, which can thus be done neatly and cheaply.

In making the belt punch, the rivet hole is first drilled and then counterbored a little more than half-way through. The part to be trimmed is then put on *B*, the stem of the die, Fig. 3, which just fits the counterbored joint. It is then swung under the heads of the strippers *E*, which also act as stops. The part to be trimmed must be counterbored to such a depth that it will rest upon the stem *B* and also upon the dies *D*. Fig. 2 shows the top of the die, and *C'* shows the position of the punch when the dies are set up. In making the die, the parts *D'*, which are the cutting parts of the die, are dowelled and screwed to the base *G*, meeting at the center to allow the hole to be bored the size of the stem *B*. They are then cut away to the required shape.

The punch, Fig. 4, of which *F* is the holder and *H* the stem which fits the press, is made the same way as the die. The ribs *R* are put on the die-base and punch-holder to prevent the die springing away from the work. The hole in the die should be tapered slightly larger toward the back, thus allowing it to strip easily.

C. H. WILCOX.

How Does a Check Nut Work?

Editor American Machinist:

If there is anything mechanical about which there is nothing more to be said, anything that has been long ago settled for all time, anything that everybody knows all about, I suppose it is the check nut. In fact, I am quite inclined to think that "chestnut" is only a slight corruption of check nut. There is perhaps no title more likely to repel a mechanical reader, nothing more likely to suggest a raking over of straw completely threshed out, than this. I must confess to having looked at the letter signed by Nick L. Steel, in the "American Machinist" No. 6, with more or

less condescension. Of course, I at once struck the old story. The writer of the letter referred to has simply come to the conclusion, reached long ago by thinking mechanics generally, if not universally, that, of two nuts, a thick nut and a thin one, or a jammer and a jammee, the thick one should be the jammer, and should of course be on the outside. Unfortunately, the writer gives a check nut illustration that cannot well be dismissed as belonging quite to the old and familiar category. The illustration may, indeed, have been brought forward to provoke us to do a little thinking, and if so, it has been more or less successful in my case. Whether the thinking leads to anything is another question.

Well, now, how does a jam nut work, anyway? Everybody knows, and very few don't know it wrong. Here we have a long screw thread, straight and true, with two nuts on it of equal thickness and with true faces to each. We hold one of the nuts with a wrench, and with another wrench we screw the second nut against the first until there is a tensile stress of, say, a ton on the screw at the plane of contact of the two nuts; the pressure of the nut faces against each other is of course also a ton. In opposition to the ton of pressure against the face of each nut there is another ton of pressure distributed over the opposing screw thread surfaces of each nut. If the thread is a V thread the pressure on the thread surfaces will be of course more than a ton, on account of the angle, but we need not here take that into consideration. To turn one nut relatively to the other we must overcome, for the nut that is moved, the friction caused by the ton or more of pressure on the face, and also the friction caused by the ton or more of pressure on the screw threads. One nut here evidently is very effective in preventing the turning of the other, and we take this in our minds as an instance of the efficacy of the jam nut, and we put our jam nuts on everywhere in full faith that they will, by their jamming or friction-producing action, prevent the nuts unscrewing. The jam nut does not really contribute a pound of additional pressure, or any resulting additional friction to the nut that is jammed.

The case is a rather curious one. Take a bolt going through a connecting rod strap and holding the sides of the strap snug to the stub end, a very common place, and a very proper place to use jam nuts, if there is any proper place for them. We assume, of course, that all the surfaces are true and everything in correct mechanical condition. The bolt being in place, we take a single nut of standard thickness and screw it up until we have a tensile stress of one ton on the bolt. We have now precisely the same pressure, and the same friction to prevent rotation, that we had with the two nuts jammed together. There is the pressure of one ton on the face of the nut and the opposing pressure against the screw thread surfaces just the same as before. Now take off the nut and put a washer under it and screw the nut down to the same bolt tension as before. The nut friction is the same as before, and there is no apparent reason why the nut is not held from turning as surely as before, but not more so. When the nut did turn, it might slide on the surface of the washer, or the washer might turn with it, and this alternative of two moving surfaces might make it perhaps infinitesimally easier for the nut to turn than before, but practically there could be no appreciable difference. We now discard the washer, and put two nuts on the bolt in the most approved style, putting on first a thin nut and then a nut of standard thickness outside. The thin nut, being only, say, one-half the thickness of the other, cannot, of course, be screwed up to the full tension required. We, however, tighten it somewhat, so that it may put a stress of perhaps half a ton on the bolt. Then we put on the thick nut and tighten it until it bears on the thin nut with a pressure of one ton. Now what is the thin nut but just a washer? The thick nut, which is the responsible nut, has precisely the same pressure and the same holding friction that it has had in our previous instances, and the thin nut has not contributed an ounce to it to prevent its unscrewing. The elasticity of the bolt, responding to the greater pressure applied by the outer nut, allows it to elongate somewhat, and the strap and stub ends being also compressed a trifle more, the thin nut is relieved of its work. The total pressure upon the strap is not the one ton of the outer nut plus the half ton of the inner nut, but only that of the outer nut alone. If the inner nut is not relieved of all its work, and if there is any more than one ton of pressure on the strap, then, as there is only one ton upon the other side of the thin nut, if there is any tendency for the outer nut to turn, it will turn above and not with the inner nut. It is evident that it is not in the least hindered in its turning by any of the traditionally assumed check nut action. The question really seems to be, not as I have put it at the top of this letter, "How does a check nut work?" but, does a check nut check? It seems to me rather that, as you have two nuts on the bolt instead of one, it will of course take longer for the two to work off if they want to, and that's all.

The case brought up in illustration by Nick L. Steel is a true case of check nut action, and at the same time it is another suggestion as to its unreliability. In this case, it will be remembered, the nuts are not tightened down upon anything to hold it, but are only tightened against each other to hold them both in position. Assuming the same sizes that we have had in our minds all along, these two nuts, one of them being a thin one, cannot be tightened against each other with the full pressure which we assumed when both nuts were of the full standard thickness, because the thin nut is not able to stand it. We assume that they press against each other with a pressure of half a ton. This is on a valve-rod pushing a slide valve back and forth. There is against the thin nut an intermitting pressure of, say, three-quarters of a ton at the maximum. Then at a point in each stroke the nut becomes a washer, or is relieved of all thread tension, and therefore must be in a condition to unscrew quite easily if it had any invitation to do so. Here also, as the check nut does not check constantly, but ceases to check for a portion of each engine stroke, does it really check at all? If a check nut checks, when does it check?

TECUMSEH SWIFT.

The Use of the Surface Gage.

Editor American Machinist:

There is perhaps no tool in the machinist's outfit more valuable than the surface gage, and perhaps none more neglected by some machinists. I fortunately was early initiated into its use, and it soon became indispensable on general work. There are of course shops where this tool would never be required and where general machine work is not done, but it is a misnomer to call the employees of such places machinists.

Your issue No. 6 had an article on the quartering of locomotive axles. In this case the use of the surface gage was shown, but not to its full extent. The centering of a shaft or axle can be done with the surface gage to the one-thousandth of an inch, and without the use of any circle struck in the lathe and without the use of the lead filling and center or T-square, and I think it can be done much quicker and with less chances for error. The reference to the thousandth of an inch of course refers to the lines only. When it comes to drilling the centers the drill may run a trifle.

At Fig. 1 are shown the different operations in the quartering and laying out of a keyway in a locomotive axle. The axle is shown supported on V blocks. Taking the surface gage, we set the pointer to the center of the shaft, approximately, and scribe a short mark at each edge. Then turning the axle half over we make two more similar marks. They will probably be 1-16" or ⅛" apart as shown at *A*. We then reset the pointer to the center between these two scratch marks, and the second or third

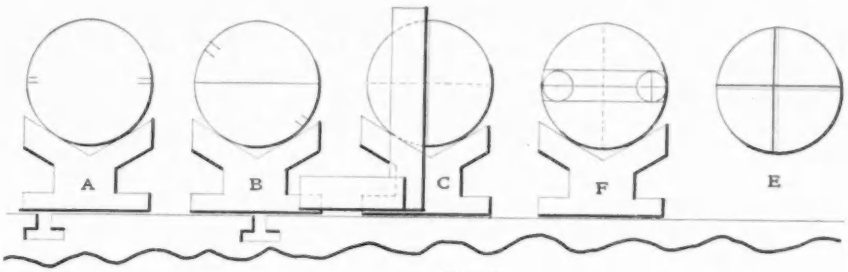


Fig. 1

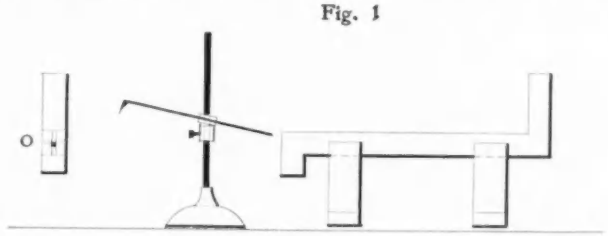


Fig. 2

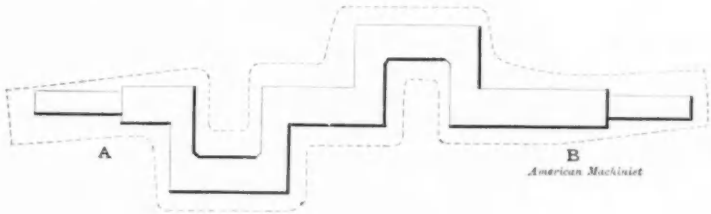


Fig. 3

USING THE SURFACE GAGE.

trial will give a line as shown at *B*, and with a fine sharp point and the naked eye we get far more accurate results than can be got by any method of transferring centers by circles or center-square. Of course, if we get a slight opening between the two lines as at *E*, it is just as well, as we can then prick-punch between the two lines. The operation of quartering is then followed up by the usual method, namely, squaring up the line, *C*, and scribing the other end of the axle, making circles of a diameter equal to the width of the keyseat and a line for depth of same.

Of course I am aware that in locomotive work the lead-filling and circle are useful for further operations on the wheel centers, but the method I show is good for any work and more specially for rough forgings. Of course it will be understood that to get the center we cross the lines as at *E*.

Fig. 2 shows the method of laying out the centers on a rough casting or forging with the surface gage, and it was spoken of by the foreman of the shop as a very difficult piece to center. It will be seen that there are two horns on the shaft projecting up and down. In this case it was only necessary to get blocks high enough so that the horns would clear the table, and then turning the shaft to four different points and scribing the small square at *O*. We then center with a prick-punch, drill and countersink; and as the job was done quickly we were quite pleased to know that we were perhaps not over 1-64" out on the rough shafts, and I was pleased also to know that we had again stolen a march on that necessary abomination, the square center.

At Fig. 3 is shown a finished crank circumscribed with dotted lines to show the original rough forging. This shows that by placing the V blocks at *A* and *B* and making the usual crossed lines shown at *E*, Fig. 1, we are enabled to get out a finished crank without any cut-and-try centering, and without any bending. Of course, the drawing is slightly exaggerated, but in actual practice and on heavy work it is well to know the uses of the tool spoken of and about which so little has been written.

This letter is of course not so much for the older hands as for that coming generation of young men who will have fewer chances of learning the trade thoroughly than the old-timers had, on account of the specialization of machine work. At the same time it is rather surprising to find that there are so many even, holding positions of foremen and the like, who know comparatively little about the use of the surface gage. One little letter or the practice of one individual will hardly do it full justice.

JOHN GRIME.

Making Jigs.

Editor American Machinist:

I was very much interested in Mr. C. H. Rowe's article on jig making in No. 6. But there is one trouble that he does not help us over, and that is this: There are not enough "up-to-date" shops in this country for all of us to work in, and therefore we have to devise other means to accomplish the same results in the "average" shop that he does in his up-to-date ones.

A method of making jigs in shops not as fully equipped with tools as one could wish, and one with which I have always had success is as follows:

First get a sample of the piece to be drilled in the jig. Locate and drill all holes very carefully and if the sample is thin, insert bushings. It is best where possible to make all holes in what we will call the master sample of one size.

Second, make three counterbores, No. 1 about .010" smaller than outside diameter of the jig bushings, No. 2 about .003" small, and No. 3 exact size.

Take the casting of the jig, plane it up and scrape the bearing surfaces so it will stand firm.

Place the master sample in the jig, and locate all adjusting screws and binders. Transfer all the holes from the master sample to the jig and drill. All holes can be transferred close enough with a scratch block on a surface plate. Holes should be drilled in jig to within about .030" of the size of the small counterbore. After the jig is drilled take the No. 1 counterbore, and run its pilot in the hole in the master sample, and thus counterbore all the drilled holes in the jig. Repeat the operation with counterbores No. 2 and No. 3. Make your bushings and after you have ground and lapped them, and forced them in, you will have a jig that is as true as your master sample.

F. YOUNG.

Making Emery Polishing Belts.

Editor American Machinist:

Perhaps the following account of the method of coating emery belts which I have seen followed with success in needle works may be of assistance to those inquiring for information on the subject. Two operators are required, and the tools consist of a six or eight inch pulley and two sections of broom handle about eighteen inches long. The emery —preferably hot—is held in a shallow box of suitable size, which is placed on a table or bench of such width that the operators may work from opposite sides. A support for one end of each of the sticks is provided in order to leave one hand of each of the operators free while applying the glue, which is done with a wide brush by one, while the other feeds the belt around, thus making this operation a matter of a few seconds. The glue being applied, the sticks are grasped at both ends, the belt drawn taut, and the operator on the pulley end leans forward and brings the pulley down smartly into the emery, at the same time drawing it towards him, the operator on

the other end, of course, following his motions, this being repeated as often as necessary to cover the belt. The weight of the pulley serves to imbed the emery in the glue better than if it were merely sprinkled on the belt.

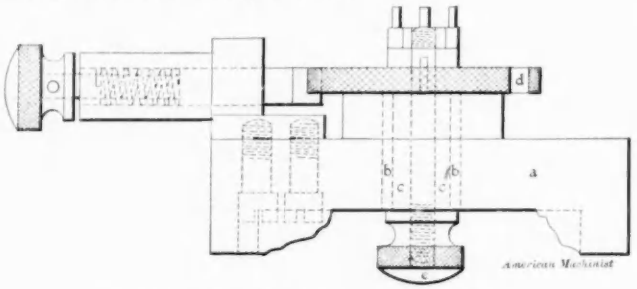
The belts are then hung up till perfectly dry before using. These belts were about four inches wide, with about six feet length of surface, which was always coated at one operatiton.

NEEDLE.

A Milling Fixture for the Drill Press.

Editor American Machinist:

Among the various parts of a camera manufactured by a certain company, is a nut with three pins, which forms a part of the roll-carrying device for the film. This nut formerly was laid out in three divisions and drilled. The pins, rounded on the ends and cut off to length, were then driven into their respective places, all consuming, as they were made by the thousands, a large amount of time. The fixture, of which I send a sketch, while not exactly the same in some minor details, is practically a facsimile of one that was designed to mill these pins on the nut from solid brass, thereby dispensing with the cutting off, drilling and necessary handling to assemble the parts in the old way. The rig consists of the cast iron ring *a*, which is turned all over, recessed on the bottom, and has a projection turned on the top, the whole bored to receive the hardened bushing *b*, which is driven nicely into the casting and lapped to fit the hardened and ground sleeve *c*, through which the arbor passes that holds the work. The index plate *d*, which is knurled on its periphery, is keyseated and fitted to the feather on the arbor, the whole being bound together by the binding nut *e*, which it will be seen binds the index plate, arbor and sleeve together while allowing them to turn freely in the bushing.



A MILLING FIXTURE FOR THE DRILL PRESS.

The indexing mechanism consists of the sleeve containing the spiral spring and plunger which is driven into the angle iron and held in place by the pin. The back end of the sleeve is splined, and a small pin in the plunger, when it is withdrawn and turned, keeps it back while the index plate is being revolved. The cutter is a small hollow mill with a taper shank, which fits an adapter for the drill.

In practice the fixture is clamped to the drill table, the mill is run down on the brass nut to the proper depth, leaving the first pin. The stop collar is then set on the drill press spindle; the index plate, carrying the nut and arbor, is revolved one division, the mill is again run down and so on through the three divisions, moving the fixture in or out on the drill table, as the case may be, until the pins are at the exact radial distance on the nut.

W. E. CALLAGHAN.

"Consulting the Workmen."

Editor American Machinist:

In your issue No. 6 I read a communication from Mr. Tecumseh Swift with the above title. He says the writer of the article on "Estimating Costs" gave him an opportunity to say a word. He says several, none of which, however, apply to the writer of the article referred to.

There is nothing in that article to indicate that the workmen were not consulted, neither is there a word intimating that under any circumstances it would be made unpleasant for the workmen. In regard to consulting the workmen, I am sure the man who undertakes to run a shop all alone cannot make a great success of it. The fact is that I have always consulted freely and frequently with my men, and I have found about one man in ten who knows less than I do, while the other nine know much more about the matter under consideration. This is so much the case that at times it seems useless for me to be around; that the whole place would perhaps, be run just as well by the men.

In regard to making it unpleasant for the workmen, the article referred to had no reference to anything unpleasant. An investigation does not necessarily mean what is sometimes called "jacking up," or a reprimand or fault-finding, but simply that a consultation can be had, the trouble located and a remedy applied. Although we may not make public just what we say and do, it is being said and done pleasantly and profitably to all concerned.

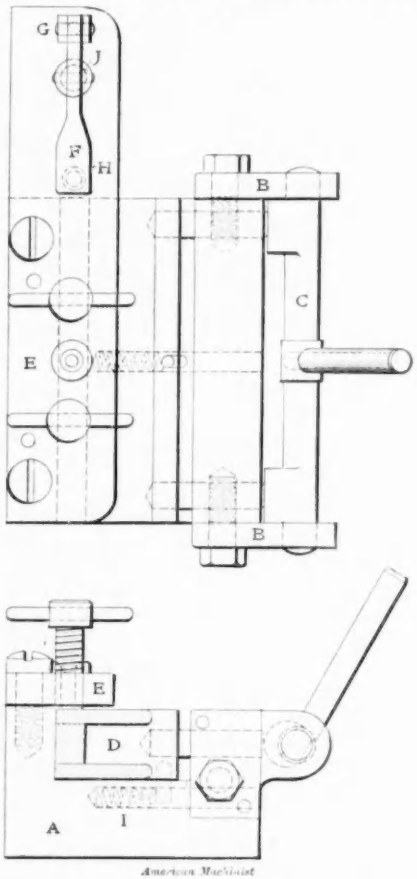
B. W. T.

A Special Drilling and Spacing Jig.

Editor American Machinist:

It was required to rivet together three strips of cold rolled steel about five feet long in the position as shown in section in the sketch, forming a U shaped bar. First it was essential that the edges of the strips should be in line, and not overlapping the center strip, and, for appearance, the rivets ought to be equally spaced. This jig was designed to meet those conditions.

A is the cast iron base of the jig; *B*, two plates screwed and doweled to *A*, and acting as bearings for *C*; *C* is of tool steel, turned so as have two cams with



A SPECIAL DRILLING AND SPACING JIG.

⅛" throw. *D* acts both as a spacing block and a clamping jaw. The part of *D* which lies between the side strips is machined .005" less than the center strip, so that the thumb screws in *E* will be sure to bind the strips firmly together. As will be noticed, *D* gets a bearing on the center strip and also on the edges of the side strips. The cams on *C* give motion to *D* by means of two ¼" steel plugs which work freely in the holes in *A*, but a tight fit in *D*, care being taken to have the projecting ends of rods equal in length from the face of *D*. *E* is a plate screwed and doweled to base *A*, in which are the drill bushing and the clamping thumb screws already mentioned, and also *F*, which is a stop pin to space the distance between the holes.

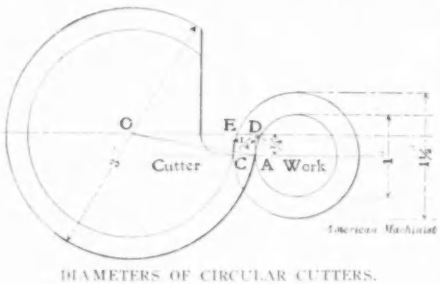
F works on a pin at J and lifts pin G by pressing down on F at H. Underneath F at H is a coil spring. The hole in the end of F, where it is jointed to G, is elongated, so as to avoid cramping in E as G moves up and down. I is a coil spring for the purpose of withdrawing D from the strips after the cams are thrown back. S. P. A.

Diameters of Circular Cutters for Forming Tools.

Editor American Machinist:

In your issue No. 1, of this year, there appeared a graphic method of finding the several diameters of circular forming tools for the screw machine. It occurred to me at the time that the method, while correct, in so far as graphic methods can be, is not accurate enough for the requirements of shops where the limits for error in work are very small. When a tool of this character is to be made in our shops, the rule is as follows:

A cutter is to be made, for example, to turn or form a piece which has two diameters, 1 and 1½ inches; the cutter center is to be ¼ inch above the center of the work, and the ground face of the cutter is to be in the horizontal plane of the center



DIAMETERS OF CIRCULAR CUTTERS.

of the work, as shown in the sketch. We start by assuming the large diameter of the cutter, which in this case will be 3 inches. The cutting edge A, which is on the circumference of the large circle, reduces the work to the small diameter, or 1 inch. The larger diameter of the work must be cut to size by cutting edge C, which is on the smaller step of the cutter. The diameter of this circle is unknown, and to find OC, the radius, is the problem.

A little study of the sketch will make it plain that

$$OD = \sqrt{(OA)^2 - (DA)^2},$$
$$OE = OD - ED,$$
$$OC = \sqrt{(OE)^2 + (EC)^2}.$$

This gives the radius of the circle which determines the cutting edge C. The operation is repeated for every diameter required.

The results of this method are as accurate as figures can make them, the accuracy being limited only by the number of decimal places to which the results are extended. CHAS. N. MCFARLAND,

Chf. Draftsman, Amer. Arithmometer Co.

St. Louis, Mo.

Laying Out Work in the Shop With Common Tools.

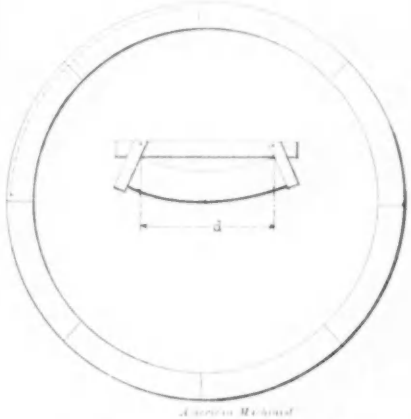
Editor American Machinist:

I suppose all of us are sometimes confronted by the question, "How close can a person work with ordinary appliances?" Assume a cylinder 8 feet in diameter, built up of eight segmental sections with planed radial flanges, the segments all cast from the same pattern and consequently identical in form; how shall we proceed in fitting them together? This is a very simple proposition, but I cogitated over it a few minutes before I planed any flanges.

Here is a plan of the cylinder. I first laid it out full size. This is the good old fashioned "practical" way, and anybody who has ever hunted around a machine shop for a flat surface big enough to lay out an 8-foot circle on knows how practical it is. Then I began to wonder what a table of chordal pitches was for, and to realize that it is a very easy matter for a person to be very stupid. Then I cut off a piece of ¼" x 1½" iron bar about 5 feet long and planed one edge. I cut two short pieces from this and riveted them to the long piece as shown, the distance a being the chord of 45° on the inner circle. The angles were found by an ordinary bevel protractor of the Starrett make, and the chordal distance d calculated from a table of chordal pitches. When the plates were assembled they fitted very closely, the last joint standing open so that a postal card could be inserted for about half an inch, but it readily closed under the pressure of the bolts. It will not do to set your planer head at 22½° and trust to luck. The distance d is an established fact, and the plate must be placed on the planer so that when the templet is tried on after the plate is planed it exactly fills the templet, the inner corners coming against the bottom straight edge of the templet.

Again, given a circular flange to be drilled for 32 bolts on an 87" circle. Now it is just about as easy to calculate the chordal pitch *which you want* as it is the circular pitch which you do not want. You probably haven't a 48" scale, but you ought to have a 24" scale and should be able to borrow another. Place these end to end on a flat surface; have your trammel points sharp, and set them at 43½". Chalk the surface of the flange and strike the finest possible line for your bolt circle. Then set the trammels for the chordal pitch already calculated, and if you have used reasonable care you ought to come out within certainly 1-16" of the starting point. I have frequently come fairly on the mark the first time. If you overrun the starting point do not try to reset the trammels, but space around again, crowding a little to the outside of the bolt circle. If you fall short crowd to the inside of the circle.

There is another point about calculating the chordal pitch, and that is it is a positive check as to the number of holes. I have, at one time and another, made a good many gears, sweeps for large gears, core boxes for cored gears, and so forth, and in my early days used the "practical," lay-it-out-full-size process; but it is altogether too slow and inaccurate, and consequently too expensive, to suit me. Of course it is absolutely necessary that every measurement be accurately done, for if you are going to set your trammels to measures laid off on a stick with a crooked, ten-cent, two-foot rule, you might just as well guess from the start. I am aware that all this is simple, almost to the point of being childish; at the same time, in 20 years' wandering about in the shops of the United States I have never seen these tables in use by the workmen. I have seen, however, a good pattern-maker fool away a couple of hours in



A GAGE FOR A PLANING JOB.

spacing a gear that he ought to have spaced in twenty minutes, and perhaps in five minutes.

I once made some templets for a latticed column. The first and last holes were 22 feet apart. To satisfy my curiosity, I located the first and last holes, using a "ten-foot pole" which I had made. The intermediate holes were then laid off with a 24-inch steel scale, there being, as near as I can recall, twelve consecutive measurements to be made. In eight templets thus laid off the error in no case exceeded 1-32 inch, and in most cases came out exactly. I have three fluted reamers which I made years ago. They are hardened and ground and the sizes were determined by a pair of broad-nosed calipers set to an ordinary steel scale. The reamers are nominally ¼", 5-16" and ⅜" in diameter; they are actually a little over 1-1000" over size. I do not cite these instances as samples of superior skill. On the contrary, I contend that it is merely a matter of using reasonable care, and that anyone can do the same thing.

I asked a patternmaker to make me

a hard maple stick ¾″ square about 12″ long. It measured .7475″, .7476″, .7477″ and so on, the nearest to .7500″ being .7491″. I measured this stick with the utmost care over and over again to satisfy myself that I was right. I used a Brown & Sharpe micrometer with a vernier reading to ten-thousandths. I don't know how long it took him to make it, but he handed it to me within half an hour after I asked him for it. The stick was dressed with a jointer and rubbed very slightly with fine sandpaper.

A. L. Bowen.

Launching a Gasmobile.

Editor American Machinist:

It was on a bright day in June that Mr. B. called at the shop to tell us some of his many troubles in trying to start the gasoline motor which he had mounted on a vehicle he had invented and constructed.

He opened up by saying that he had been trying one year and three months to get this particular engine and another he had tried previously to run, and had failed. He was feeling very blue over the prospects of the motor ever running. I fell into a sympathetic mood, and volunteered to lose a half day and try to help him out, besides being in at the launching of a motor vehicle. As this was my first experience I thought I could learn something that would be of benefit to me as well as to B. So off I went at dinner time, arriving at B's place about 2 o'clock. I looked the thing over, felt dubious about the design of transmission gear and steering device, but confident about the motor. I did not comment then on the design, but pulled off my coat and went to work on the motor, which proved to be a 3″ x 3″ of the two cycle marine type, with no governor nor means of speed regulation, except a brake which B. had put on the flywheel. It took me about ten minutes to get the mixture so adjusted as to get it started. B. said it would not run two minutes continuously, but I had made a more accurate adjustment of the mixture than he had anticipated or had been able to get himself, and the engine kept up its pace of between 300 and 400 revolutions per minute, which fairly scared B. out of his boots, as the vibrations of his vehicle made the building and everything about dance the same two-step. He implored me to stop the engine, which I did, at the same time reminding him that it had run longer than two minutes. He nodded his approval, but explained that such vibrations would never do. I saw he was losing nerve, so I encouraged him, saying he surely would not get a man to come way out here to start him right and then not let him see his machine on the road demonstrating its practical qualities. So he finally consented; we rolled her out into public view and it was not long before the people assembled *en masse* to see the wonder on her first voyage. Now B. was a firm believer in power being applied to all four wheels, and his carriage was constructed accordingly. He also believed in power steering and this method was provided for, but he did not believe in the Jack-in-the-box or other compensating gear, and had used square-jawed crab clutches attached to each wheel hub, these clutches allowing the axles to turn about ¼ revolution before touching or gripping. Now this scheme would work out if he could have made as many right as left hand turns and they had all been of the same radius, but we did not get quite that far along.

To steer he swung his front axle by means of a coarse pitch worm working in the segment of a gear attached to the front axle. This would not have been so bad had he run the worm slow enough, but he had miscalculated the speed, and it ran about 300 R. P. M. This worm was thrown in and out of gear by two crabs, one giving the left turn, the other the right. B. mounted the seat with a couple of years' enthusiasm and dreams under his vest, amid the cheering of the crowd. I started the motor and told him I would walk behind and reach under the back seat and open the pet cock on top of the cylinder to stop the engine in case he should run amuck, mis-steer or what not. The expected, on my part, happened very soon. B. threw in the clutch and the carriage forged ahead, but, alas, he thought he would try the steering device, and threw in the crab. The carriage made such a short haw turn, and that so quick, that I thought it had turned inside out. I got the engine stopped just as it was about to enter an undertaker's office by way of the window. We pushed it back on the street and started over again, but B.'s steering device responded too lively for an amateur mobilist and we drew up this time on the edge of a ditch, just in time to save the rig and ourselves. B. had had enough by this time, so we pushed it back to his shop amid the guying of the throng. However, I enjoyed it very much and B. saw his machine demonstrate its weak points and very few of its virtues.

It appears to be a fact patented that it is useless to point out the weak points in design to some inventors. The only way to convince them is to let them make a demonstration and if that does not wilt them, have a committee appointed to put the micrometer on their mentality.

Fred. C. Tygard.

Pittsburgh, Pa.

The Twist Lip Planer Tool.

Editor American Machinist:

Referring to "The Twist Lip Planer Tool" in No. 6 of the "American Machinist," the writer is a little behind the times, for I had the same tool in use in 1893. I was employed in Chicago at the time, running a planer. At my right hand was a man from Montreal, and in his kit was one of these tools, from which I copied mine. I said to him that I never saw one of those tools before, and the answer I got was that it was an old idea, as he had carried that particular tool about ten years. The finer the feed the better the results. The tool will work equally well as a lathe tool. I would not be without one, as for finishing steel and brass it has no equal. At the same time if it is desired to take a very light chip, say .003″, it can be easily accomplished.

A. F. Horton.

Providence, R. I.

[We have other evidence that this tool has been known for a long time, but it is nevertheless not generally known, and in many shops has never been seen or heard of. We do not think it is correct to say that because a contributor describes in our columns a tool or device that may have been known to some or to a few for a long time previous, he is therefore behind the times. Men who are most thoroughly up to the times often run across tools which, though old, are not generally known and are therefore new to them.—Ed.]

Trouble With Coke in the Cupola.

Editor American Machinist:

On my return from Arizona, I laid over for a few days in El Paso, Texas, visiting a friend of mine, the proprietor of a foundry and machine shop. While there a telegram came from a firm running a foundry in the southern part of the Territory, asking him to send a man there to find out what was the matter with their cupola, or the reason they could not get soft castings. My friend asked me to go, and as I had not been in that part of the country I thought I would take it in.

When I arrived there I found things as stated. The castings, both light and heavy, were white and brittle all through them, and they could not tell the reason, unless it was the daubing they used to fix the cupola with. I knew it could not be that, as I had used the same kind of silica sand in Jerome. I resolved to take off a heat. They had some very good-looking coke, so I did not think the trouble was there; but when the castings were turned out they were no better than the others that they had made. The second heat, also, was no better, so I started in to find out the trouble. I neglected to state that this was at a copper smelter,

and that they used a variety of fuel—coke, soft coal, and hard coal. Being down at the smelter the next day I saw this hard coal, and it struck me to try it, as I had an idea that it was the sulphur in the coke that caused all the trouble. It should be stated here that there was not a pound of pig iron in the place, but some very good scrap that should turn out very good castings under ordinary circumstances, and with the coal everything came out all right. So, after we had found out what was the trouble, I asked the superintendent to get some Connellsville coke. When that came I took off a few heats with that, and everything was O. K. Telling this to a friend of mine, the other day, he told me that he had been in the fix himself once, and the way that he got over it was this: He put all hard coal on his bed in the cupola, and the castings were all right, and that he thought that the coal neutralized the sulphur in the coke.

THOS. WATHEY.

Tool Room Requirements.

Editor American Machinist:

We hear a great deal about improved tools. They are fully described and illustrated as they come along, but the place where they are kept when not in use, "the tool room," is generally, like the grindstone, in the darkest and dirtiest corner of the shop. I am interested in the storage and care of tools and always in looking over the "American Machinist" I watch for something on this subject, but I am very seldom rewarded, and I do not think I am the only one thus disappointed. I have the care of tools in a very large manufacturing concern, where the men get tools out on checks, and my experience may help some other knowledge seeking tool keeper.

There should be plenty of light in the tool room, daylight, if possible, but artificial is all right if the lights are properly placed, and there are enough of them. Then the tools should be so placed that they can be got at quickly, as a good tool keeper does not like to see a crowd of men waiting and the owners probably feel about the same.

There should be plenty of tools to supply the demand at all times, as the cost of the tools will not equal the value of the time that may be wasted in looking and trying to borrow from another man. I am speaking of small tools, such as drills, taps, reamers, etc. A man can waste enough time in looking for a drill or a tap to pay for it in a short time. Much time can be saved by grouping all tools for doing a certain piece of work in a block. For instance, you can put a reamer, drill, reamer wrench and a standard plug in a block, and the workman gets the four tools on one check, and you can do the same for a hole that is to be tapped. Then the tool keeper ought to be a person that is willing to hustle when there are men waiting. He can always get time to rest when the rush is over.

As it is not always possible to examine tools for sharpness at the time they are turned in, it is important that the tool keeper should look them over the first spare time he has, and if they are not all right have them made so, as the tools ought to be all right for the workman to use when he gets them out. Much time is wasted by workmen when they get a dull tool, in grinding it themselves or in waiting for the man that runs the grinder to do it for them. Some people think that any person is all right to care for tools, but this is not so, as an intelligent tool keeper, one who takes an interest in his work, can save his own wages for the firm every day. The above considerations have helped me in the care of ordinary tools, such as every tool room has or ought to have. Special tools are in a class by themselves.

TOOL KEEPER.

Sawdust Mortar as a Steam Pipe Covering.

Editor American Machinist:

We had to convey steam nearly 700 feet, and no one in our locality could say for a certainty what the loss by radiation would amount to. Text books gave 12 per cent. if the pipe was left uncovered, and only 2 per cent. if the pipe was well protected with a coating of hair felt. We proceeded to test this to our own satisfaction.

The pipe was put up, starting at the boilers with 8" and rising straight up 20 feet, thence on an incline down towards its terminus. The fall was a gradual slope all the way, amounting to 15 feet in its whole length. If we except the riser we have 197 feet of 8", 219 feet of 7", and 258 feet of 6" pipe in a straight, continuous line, with a dip so pronounced that the condensed water cannot flow back into the boilers, but must continue on to the extreme end, the lowest point, and there a common 18" patent trap was connected in.

All of the branch pipes supplying the different departments with steam were taken from the top side of the main. Each branch inclined down and took care of its own condensation. This left the main free to give the basis for computing the efficiency of a new style of covering which it was proposed to use. Steam was turned on and for a period of twenty days the pipe was left uncovered, its whole length being exposed to the open air, excepting 60 feet, which ran under a shed-like structure. During this time a record was taken daily of the amount of condensation.

The process of covering consisted of casing the pipe in a wooden box 12" square inside, then filling in with sawdust mortar, tamping down good and hard. One side of the box was made 2" higher by nailing on a 2" x 2" strip. Car roofing, cut 18" long, was used for cover, the 2" dip being sufficient to shed water.

The sawdust was mixed up the same as a sand mortar, proportioning one barrel of lime to five of sawdust. Five days was allowed for this covering to dry, after the job was completed. Then for another period of twenty days a daily record was taken.

A summary of the data secured shows that the uncovered pipe condensed 1,440 pounds of water per hour, or a fraction under 1¼ pounds per square foot of external area per hour. The same pipe, covered as stated, turns out a loss of 195 pounds of water discharged at the trap per hour. In other words, the condensation amounts to 2¾ ounces of water per hour for each square foot of external pipe area.

F. A. NYSTROM.

Blackmailing Collections.

Editor American Machinist:

I have seen many shop abuses discussed in your columns, but there is one I have never heard a word against. I refer to the custom of buying presents for superintendents and foremen. To my mind it is one of the most despicable forms of blackmail ever devised. My first experience with it was when we were asked to "chip in" and buy a $100 set of instruments for the retiring head draftsman. Of course we all did so, though most of the foremen in the works did not know him, let alone the men. A few months later the superintendent also retired; another dollar out of our pockets. In some places where changes are made quite frequently the tax is a severe one. Last year I was employed in a large machine works in New England. A foreman left there, on an average, every three weeks. In every case it meant a collection in the department in which he had been employed. As if that was not bad enough, when a foreman was transferred from one department to another the men in the department he left felt it necessary to buy him a present, and then, to cap the climax, one of the foremen, who never expected to leave or to be transferred, went about complaining that if he would only quit his men would give him a present, but as long as he staid they never gave him anything; so his men felt compelled to buy him a Morris chair.

The same way if a foreman got married, his men must give him a present, though I do not think they were included in the wedding invitations. A few weeks since, the superintendent retired. He should have done it five years ago—but then that's another story. It was the same old game—a collection to buy him a gold watch and

chain and a diamond shirt-stud. How he could have accepted a gift from his men I do not know. His only recommendation to the company was that he was a good man to cut down wages; not cost of production, mind you, but wages. Cost of production steadily rose under his management, as was but natural. Yet his men felt compelled to buy him a gift on his retiring. For what? Surely not for anything he ever did for them. I know that in most shops that are considered up to date such a thing as a collection would not be tolerated; but those of us who work in shops know that there are lots of them that are not up to date; and as the great mission of the "American Machinist" seems to be the bringing up to time of the American machine shop, I hope that some shop proprietor will have his attention called to this particular shop abuse, and stop all blackmailing collections in his shop for the future.

AN UNWILLING CONTRIBUTOR.

Friction Gearing.

Editor American Machinist:

Paper or millboard friction wheels when made up in the shop are generally, if not always, finished by turning in a lathe, but this lathe work is by no means indispensable. If the sleeve or shaft on which the friction wheel is built runs reasonably true, cut the disks about one-quarter of an inch larger than the required diameter, put them in place in the usual way and an hour's work will give the finish required. In the last fifteen years I have built and used about 400 frictions in this way.

The life of a friction wheel made of good material is affected, not alone by the amount of useful work it does, but by other conditions, and one of the most important of these is the force used in compressing the material.

I use one ¾-inch bolt to every 20 square inches of disk. It is well to watch these bolts for a few days after starting a new friction drive and take up the slack which can always be found.

Another detail that is important in this connection is the size of shaft carrying the friction wheel. It is not sufficient that it has the torsional strength to transmit the required power, but it should also be large and stiff enough to prevent excessive springing between the bearings when the frictions are in contact.

As to the dimensions of the frictions, I allow one horse-power for every 500 feet of surface speed per inch of face. This is liberal enough to cover a reasonable loss through friction. For speed I would advise against anything exceeding 1,200 feet per minute for the surface if the load is to be frequently thrown on and off while the driving shaft continues in motion. As examples of moderate and high speeds, let me cite the following two cases both of which were installed under my direction:

On a line shaft running 320 revolutions per minute there is a millboard friction wheel 12 inches in diameter with 16-inch face. This was designed to lift 3,000 pounds at the rate of 320 feet per minute, but is lifting 5,000 pounds at the speed given. The other case is a friction wheel 24 inches in diameter with 12-inch face on a shaft running 375 revolutions per minute. This is lifting 3,000 pounds at the rate of 450 feet per minute.

A little study will show that the first-mentioned is doing considerably the more work and might be expected to show the faster wear, but it does not. It is in fact showing the less wear. As to the other conditions, they are about the same, from 35 to 50 loads per hour lifted being ordinary work.

TRANSMISSION.

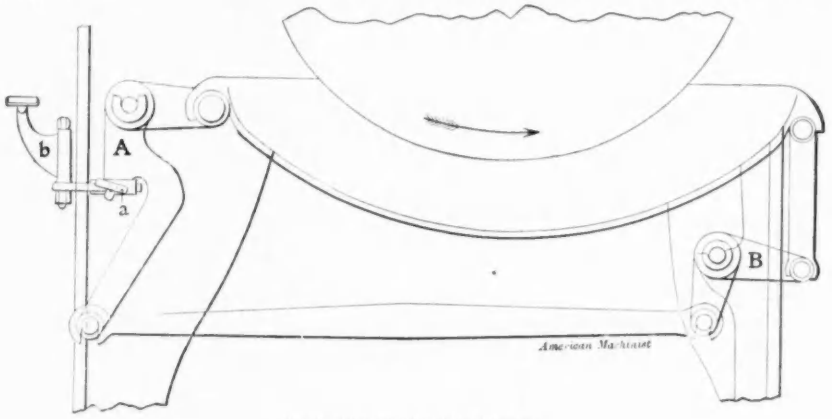
Insurance on Machinist's Tools.

Editor American Machinist:

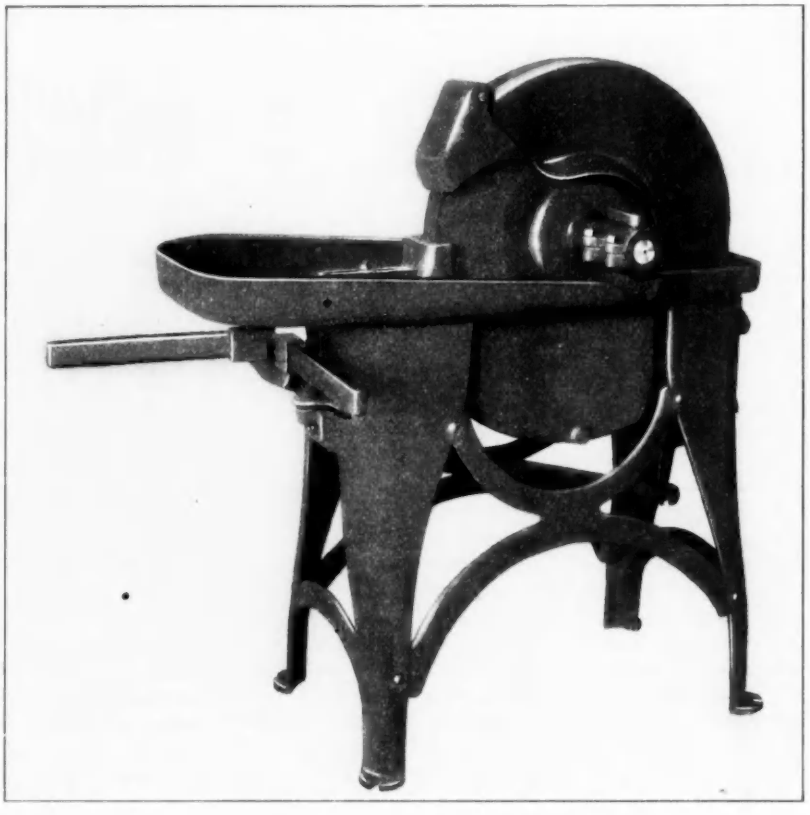
It has often occurred to me to wonder why there is not a fire insurance company that would issue policies to a mechanic on his tools. Of course, there may be some, but I have worked twelve years at the machinist trade and I never heard of one.

Now I don't think there is a mechanic that wouldn't be seriously put out if he lost all his tools by fire, because he would probably be out of a job for some time, and would want what money he had to live on, and he wouldn't feel like buying tools until he was sure of steady work again.

Now if the "American Machinist" will take this matter up I know it would be appreciated by all good mechanics. Let us hear from different sections of the



HOW THE TROUGH IS LIFTED.



A NEW WATER EMERY TOOL GRINDER.

country about this subject, which I think must interest us all.

R. W. ELLINGHAM.

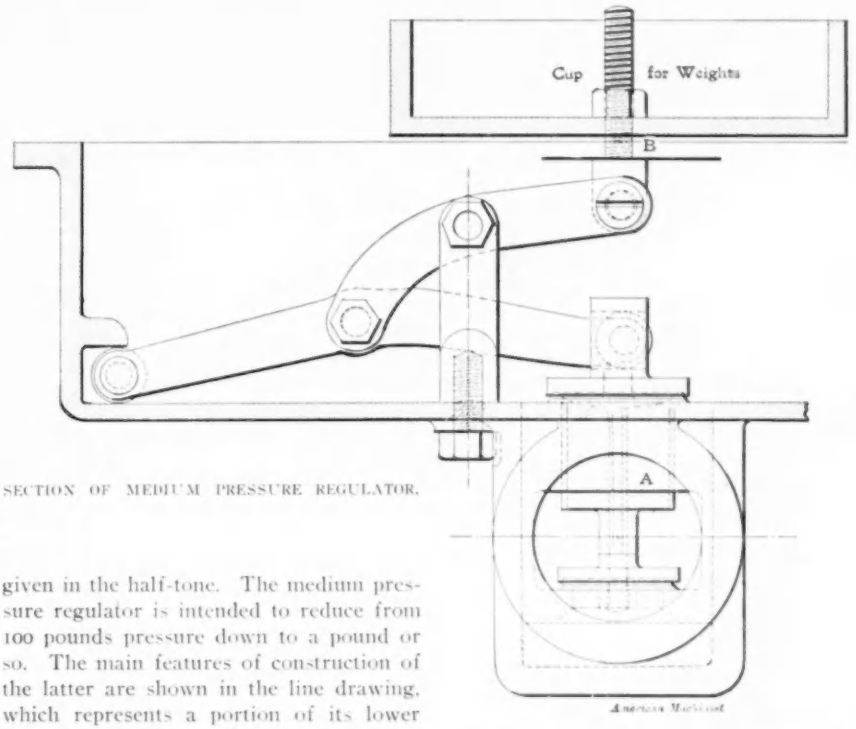
A New Water Emery Tool Grinder.

The desirability, or, in fact, the necessity, of using water in connection with an emery wheel for tool grinding is sufficiently understood, and the problem of applying the water in a way altogether satisfactory has been one not easy of solution, as is evidenced by the number of attempts that have been made and the variety of devices produced. The half-tone shows one of the latest arrangements that have appeared, in the designing of which all the requirements have been considered. Of the mounting of the wheel itself it is not necessary to speak. Ample and suitable bearings are provided for the arbor, with an adjustable hood and tool-rests which can be set as required. The feature to which special attention is here directed is the water trough. This is arranged to be raised when required, and, when no grinding is going on, to drop again low enough to bring the surface of the water below the periphery of the wheel. When the workman comes to grind a tool he merely presses the side of his leg against either of the levers, of which there are three, at the front of the machine, and this raises the trough, and the wheel is at once supplied with water, the quantity of water depending upon the pressure on the lever. The pressure required is not great, and the operation serves in fact to steady the workman, and is really restful rather than otherwise. When the pressure is removed as the workman walks away, the trough of course drops and the wheel no longer touches the water. The lever arrangement is so simple as scarcely to require any description. The casting *b*, which carries the levers to which the pressure is applied by the operator, is vertically pivoted in front of the machine, and a forked arm extends to the inside of the frame to touch the roller *a* on a stud on the lever *A*. As *b* swings in either direction, depending upon which lever arm is pressed by the workman, levers *A* and *B* are moved together, and the trough is raised. This grinder is made by the B. F. Barnes Company, Rockford, Ill.

Some New Things.

GAS REGULATORS FOR LOW AND MEDIUM PRESSURES.

The accompanying views show a gas regulator made either for low or medium pressures. The former type is extremely sensitive, and is especially adapted to give a uniform pressure of gas for gas engines or Welsbach lights. It is designed to receive the gas at not more than 2 pounds pressure and reduce it to a few ounces. It can be adjusted without shutting off the gas. An external view of this appliance is



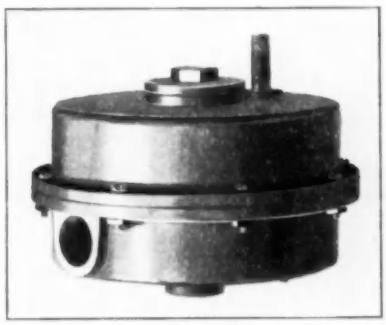
SECTION OF MEDIUM PRESSURE REGULATOR.

given in the half-tone. The medium pressure regulator is intended to reduce from 100 pounds pressure down to a pound or so. The main features of construction of the latter are shown in the line drawing, which represents a portion of its lower shell, it being essentially the same as the low pressure regulator, except that the inlet valve is a balanced one, which is unnecessary in the low pressure regulator.

The body is divided horizontally by a diaphragm of rubber or other flexible material stretched across and held between the flanges of the upper and lower shells. The space above this diaphragm is in communication with the atmosphere. The space below is a gas chamber, which has on outlet on the side and an inlet at the bottom, the latter regulated by the balanced valve *A*. This valve is controlled by the diaphragm, through a system of levers which, it will be seen, are clamped to the diaphragm at *B*. There is a cast-iron cup fastened over the screw and above the diaphragm at this place, intended to receive weights to a greater or less quantity. The downward pressure made on the levers by these weights together with that of the atmosphere on the diaphragm balances the pressure of the gas in the lower compartment on the lower side of the diaphragm, to which must be added, of course, whatever upward thrust there may be due to the net weight of the levers and valve.

When some of the gas in the compartment below the diaphragm is drawn out, it reduces the pressure there, allowing the diaphragm to move down and open the valve. This remains open until a sufficient quantity of gas comes in to restore the pressure to what it was in the beginning. If there is a constant flow of gas from the regulator the valve will remain open far enough just to balance the outgo, and thus keep the pressure almost up to that obtained when the gas is not being drawn out. The pressure is varied by changing the weights in the cup.

These regulators are known as the



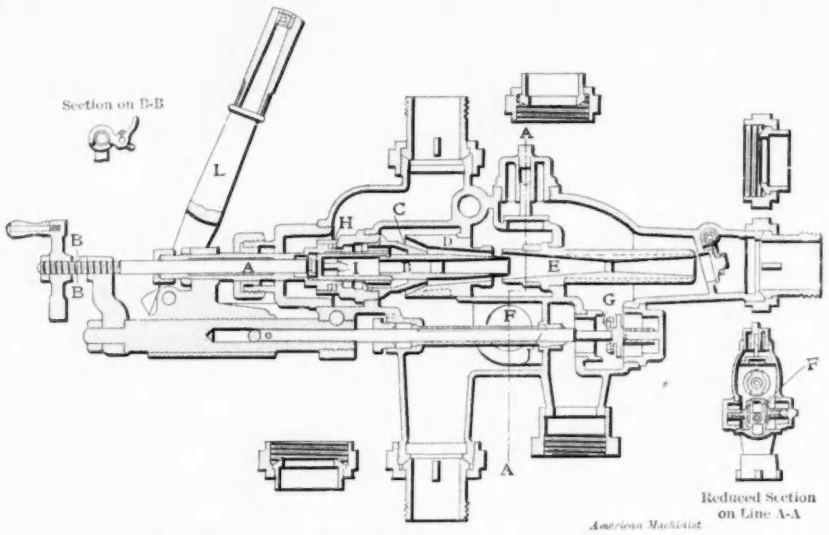
LOW PRESSURE GAS REGULATOR.

"Jacobson," and are made by the Jacobson Machine Manufacturing Company, Warren, Pa.

THE LATEST LUNKENHEIMER STANDARD INJECTOR.

The cut shows in section a '99 model Lunkenheimer standard injector, which is claimed to embody a number of novel features. These will appear in a slight description of the mode of its operation, which also may help to give the general mechanical reader an inkling of the supposed mystery attached to the operation of all injectors.

The injector is operated by the lever *L*. Upon moving this lever slightly from the position shown in the cut, the steam valve *H* is withdrawn from its seat, admitting steam to the lifting jet *C*, through the annular space around the adjustable steam tube *B*. The steam flowing into the water-lifting tube *D* forms a vacuum in the water supply pipe and the water is lifted and passes out through the check valve end also the delivery tube *E*, past the overflow valve *G* to the atmosphere. Drawing the lever farther back opens the ports *I* in the

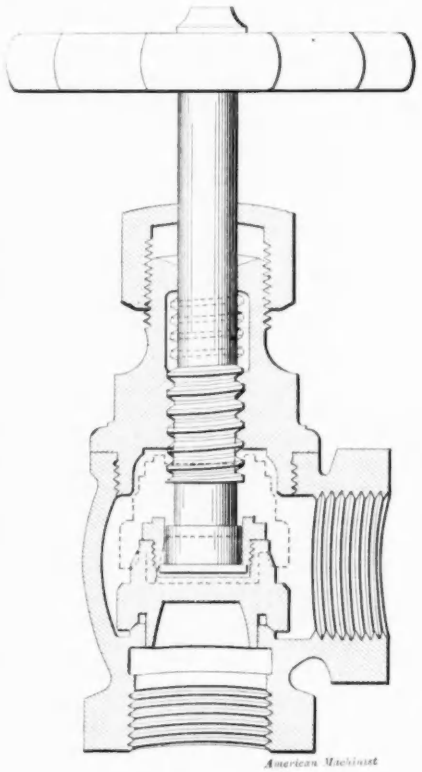


THE LATEST LUNKENHEIMER STANDARD INJECTOR.

movable steam tube *B*, thus admitting steam to the interior of the tube, which forces the water through the combining tube *E* past the live check to the boiler, due to the closing of the overflow valve *G* occasioned by the withdrawal of rod *J*. The regulation of the water is accomplished by the movement of the adjustable steam tube *B*, which is controlled by the crank handle at the end. On this account this injector differs from all others, as in cutting down the discharge of water the steam consumption is reduced in direct proportion, while in other injectors the steam supply is constant and the water supply alone is reduced. It is claimed that this injector will start promptly under most conditions and can be depended upon to work at all steam pressures above 25 pounds. It is distinctively a high pressure injector, and is self adjusting to the extent that it is not affected by wide variations of steam pressure. When started, for instance, at 70 pounds it can be relied upon to work uninterruptedly to 300 pounds, and sudden reductions of pressure will not affect it. Ease of making repairs and other mechanical advantages have been secured in the general design. The injector is made by the Lunkenheimer Company, Cincinnati, O.

LOW-WATER ALARM AND BLOW-OFF VALVE.

The Crane patent low-water alarm shown in the accompanying cut is one capable of being tested by factory inspectors, which of late is required by the laws of some States. The pipe *B* enters the boiler to the alarm line, while *E* is connected with some part of the boiler which will always furnish live steam. When the water falls below the alarm line, steam enters tube *B*, melts the fusible plug at *C* and, escaping through the hole in the wheel above, raises lever *D*. This opens the valve in whistle *F*, allowing the steam entering through pipe *E* to give the alarm. For testing purposes the valve *J* is opened,



BLOW-OFF VALVE.

allowing steam from *E* to flow in and melt the plug or gasket. New gaskets are inserted by closing valve *G* and removing nut *C*. The key *I* can be removed from valve G only when the latter is open.

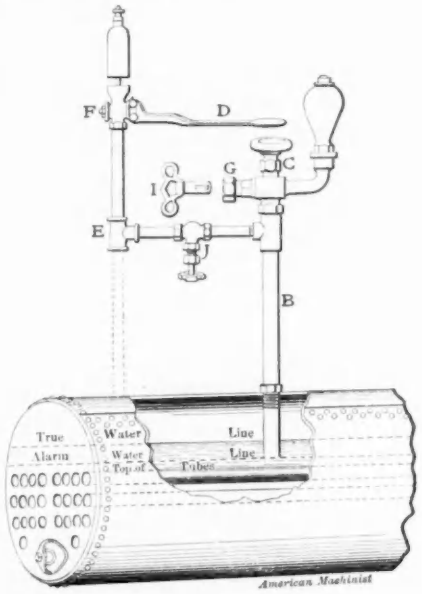
The Crane blow-off valve shown in the other cut was designed to meet certain faults commonly found in valves for this purpose. Its distinguishing features are the location of the valve seat on the outside, which prevents sediment lodging there, and the projection on the under side of the disk which prevents any discharge taking place until the seats have become widely separated. This valve is intended always to be connected from the pressure side. It can be made in either angle or globe pattern.

Both the low-water alarm and the valve described are made by the Crane Company, Chicago, Ill.

Report and Recommendations of the Commissioner of Patents.

Following is a summary of the report to Congress for the year ending December 31, 1900, of C. H. Duell, United States Commissioner of Patents:

In 1900 there were received 39,673 applications for patents, 2,225 for designs, 82 for reissues, 2,099 for registration of trade-marks, 943 for registration of labels, and 127 for registration of prints. There were 26,418 patents granted, including designs, 81 patents reissued, 1,721 trade-marks registered, and 737 labels and 93 prints. The number of patents that expired was 21,196. The number of allowed applications awaiting the payment of final fees was 8,111. The number that were



LOW-WATER ALARM.

forfeited for non-payment of the final fees was 4,215. The total expenditures were $1,260,019.62; the receipts over expenditures, $90,808.91. The total balance to the credit of the Patent Office in the Treasury of the United States on January 1, 1901, was $5,177,458.55.

In proportion to population more patents were issued to citizens of the District of Columbia than those of any State—1 to every 1,110. Next in number are the following: Conn., 1 to 1,203; Mass., 1 to 1,607; R. I., 1 to 1,623; N. J., 1 to 1,846; N. Y., 1 to 1,918; Colo., 1 to 1,941; Ill., 1 to 1,976; Cal., 1 to 2,028; Ohio, 1 to 2,419; Pa., 1 to 2,457; Mich., 1 to 3,131; Wash., 1 to 3,178; Mont., 1 to 3,201; Md., 1 to 3,742; N. H., 1 to 3,846; Nev., 1 to 3,848; Iowa, 1 to 3,978; Ore., 1 to 4,014; Ind., 1 to 4,026; Wis., 1 to 4,072; Mo., 1 to 4,142; Minn., 1 to 4,199; Utah, 1 to 4,771; Idaho, 1 to 4,900; Vt., 1 to 4,980; Maine, 1 to 5,182; Neb., 1 to 5,263; Kan., 1 to 5,327; Wyo., 1 to 5,443; Del., 1 to

6,157; Okla., Ter., 1 to 6,222; N. Dak., 1 to 6,648; Ariz. Ter., 1 to 6,829; S Dak., 1 to 7,170; W. Va., 1 to 7,923; Fla., 1 to 8,008; Tex., 1 to 8,173; Ky., 1 to 9,136; Va., 1 to 9,270; La., 1 to 9,868; Tenn., 1 to 9,953. The fewest patents granted in proportion to the number of inhabitants were in the following States: S. C., 1 to every 28,517; N. C., 1 to 23,095; N. Mex., 1 to 21,701; Miss., 1 to 20,963; Ala., 1 to 19,249; Ark., 1 to 13,248; Ga., 1 to 12,885.

As to foreign patents, 1,070 were granted to residents of Germany; England, 987; Canada, 367; France, 341; Austria-Hungary, 117; Switzerland, 79; Scotland, 76; Russia, 50; Belgium, 47; Sweden, 46; Victoria, 42; Italy, 32; Mexico and Netherlands, 26 each; Ireland and New South Wales, 25 each; New Zealand, 22; Norway, 17; Denmark, 16; Argentina, Queensland and South African Republic, 6 each; South Australia and Spain, 5 each; China, Cuba and Egypt, 4 each; Chile, India, Peru, Tasmania and Western Australia, 3 each; Costa Rica, Guatemala and Roumania, 2 each, and Brazil, British Guiana, British West Indies, Cape Colony, Haiti, Java, Natal, Newfoundland, Sicily, Trinidad and Venezuela, 1 each.

After giving a brief history of the rise of manufactures and the development of the patent system in the United States, the Commissioner passes on to a few recommendations for its future conduct. Emphasizing the advantage of the American or "examination system" in contradistinction from the English plan which has been mainly followed by other nations, he says:

"The system is by no means perfect; but it is generally acknowledged that the patent laws of the United States are more liberal than those of any other country and that the examination, imperfect though at times it be, gives a value to a United States patent not possessed by a patent issued by a country not having an examination system. It is undoubtedly true that the practice before the Patent Office lacks stability and uniformity by reason of the frequent changes of Commissioners, which prevents the establishment of definite policies. The salaries paid to the Commissioner and Assistant Commissioner, to the Examiners-in-Chief and to the Examiners of the various grades are inadequate. It is also true that too many appeals are permitted, and interference proceedings are rendered onerous and complicated by the number of motions and appeals provided by the laws and rules. The most serious defect, however, follows from the power to keep applications in the Office for indefinite times through delays in amending the same. The act of March 3, 1897, was intended to prevent or check this evil; but it has failed of its purpose. At the present time about 75 per cent. of the patents granted are issued within one year after being filed, and were it not for the fact that applications are unduly delayed, at least 90 per cent. would issue within that time. The rights of the public would be protected and very seldom would an injustice be done to an inventor if a provision was incorporated into the patent laws providing that unless an application became involved in an interference it should not be permitted to remain in the Patent Office more than three years without abridging its life of seventeen years.

"The records of the Office show that there are pending 4,829 applications filed prior to January 1, 1898. Three of these applications were filed in 1880, one in 1881, four in 1882, three in 1884, three in 1885, thirteen in 1886, seven in 1887, thirteen in 1888, nineteen in 1889, twenty-three in 1890, forty-five in 1891, sixty-four in 1892, 103 in 1893, 154 in 1894, 368 in 1895, 992 in 1896, and 3,011 in 1897.

"It will be seen, therefore, that an application may be kept alive indefinitely, if it be desired. While the list above given embraces only such applications as were filed under the law as it existed prior to January 1, 1898, yet ten years from now a similar list will undoubtedly be given, provided the statutes are not amended, for the only difference lies in the fact that amendments now have to be made within a year after the official action instead of two years under the prior act. A law which permits this should be corrected."

"The world owes as much to inventors as to statesmen or warriors," remarks the Commissioner, guardedly—an assertion which, on the whole, might be true even were the world's debt to inventors an inappreciable quantity.

The De Beers Co. Pensions Mrs. Labram.

A press dispatch from Milwaukee says: "In recognition of the service of George Labram, of Milwaukee, who as engineer for the De Beers Mining Company was one of the defenders of Kimberly and built 'Long Cecil,' the monster gun used to fight the Boers, and who was killed during the siege, the mining company has settled upon Mrs. Labram, the widow, an annuity of $500 during life, and upon her thirteen-year-old son an annuity of $1,000 until he shall become of age. This is in addition to the $1,000 recently awarded Mrs. Labram by the British Government."

We are indebted to Ludw. Loewe & Co., of Berlin, for a finely gotten up souvenir book, giving an illustrated account of the visit of the American engineers to their works and to other points of interest in and about Berlin last July. There are forty-five fine half-tone illustrations, showing groups of visitors in the works and elsewhere, and the book is one that will certainly be treasured by all who were present and who, we understand, are each to receive a copy.

Civil Service Examinations.

Among State and County positions for which examinations will be held, March 23, in twenty-eight towns of New York State, are the following: Instructor in Blacksmithing, State Institutions ($65 to $75 per month and maintenance); Instructor in Machine Woodworking and Cabinetmaking, Elmira Reformatory ($65 to $75 per month and board); Assistant Steam Engineer ($40 to $60 per month and maintenance), including also Boiler-house Keeper, State Prisons ($75 per month). Applications must be filed in the office of the Commission by noon of March 18. For further particulars and application blank, address Chief Examiner, State Civil Service Commission, Albany, N. Y.

Technical Publication.

A second edition of the lecture by Walter B. Snow, on "Mechanical Ventilation and Heating by a Forced Circulation of Warm Air," has just been issued by the B. F. Sturtevant Company, Boston, Mass., by whom it will be mailed on application.

The Hendey-Norton Universal Miller—Errata.

Owing to an unfortunate chain of circumstances a number of errors occurred in our description of the Hendey-Norton universal milling machine, which appeared at page 217. The machine is not of course a "vertical" machine, as we called it, the substitution of the word "vertical" for "universal" being due to a stenographer's error and an oversight. Then the spiral head instead of moving through an angle from 15 degrees below the horizontal to 15 degrees beyond the vertical moves from the first-named position to 15 degrees below the horizontal *in the opposite direction*, its total arc of movement being 210 degrees. Finally, the dividing head has a separate raising block with graduated base instead of it being necessary to use the base of the vise for that purpose, as was our impression.

Some of the New England textile mills are interested in the working of the Monfort comber, a German machine which is claimed to be more economical than those made in America. If the former proves to have the advantages claimed it is said to be probable that the Mason Manufacturing Company, Taunton, Mass., will take up its manufacture for the trade. Some sample machines have been ordered to be placed in four different mills in New Bedford, Mass.

The New York office of the International Correspondence Schools, Scranton, Pa., has been moved to larger quarters, at 7 West Twenty-second street. The rooms were fitted up after designs by W. Scott-Collins, principal of the School of Architecture.

Personal.

H. Wharton, who is connected with the Birmingham house of Charles Churchill & Co., Ltd., is spending about a month in this country looking about among manufacturers of machine tools.

Thomas D. West, by invitation of the executive committee of the New England Foundrymen's Association, will deliver a lecture before that body, at Boston, on the 13th inst. Subject, "Modern Methods of the Management of Cupolas, and Mixing Irons."

Rear Admiral Hichborn, who has recently relinquished the active duties of Chief Constructor of the Navy to retire on account of having reached the legal age limit, is thus complimented by Secretary Gage:

"You have been in the Construction Bureau of the Department during the transition time from the old navy to the new, and during a large part of that period have been the head of the Bureau of Construction and Repair. This term of service covers the remarkable increase of our navy, in which you have borne so conspicuous a part and which, in place of the old and now obsolete types, has substituted the torpedo boat, the gunboat, the protected cruiser, and the battleship. These stood the test of the recent war with Spain and put our navy in the forefront. I never lose the opportunity of testifying that the credit of all this is due, not only to the men who fought the ships, but to the Chiefs of Bureaus who constructed, equipped and armed them; and as one of these Chiefs you, too, have a share in the victories of Manila and Santiago. You retire from the navy in the fulness of its glory, and I congratulate you upon the fact that, although you have reached the age of retirement, you do so in full vigor and health of body and mind, and with the prospect before you of many years yet of useful and happy life."

Obituary.

Henry D. Wickes, head of the firm of Wickes Brothers, Saginaw, Michigan, died in Mexico, February 14, sixty-eight years old. Mr. Wickes was born at Starkey, N. Y.; began an apprenticeship at Penn Yan, N. Y., when nineteen years old, and in 1854, then twenty-one, he with his brother and H. W. Wood started a machine and foundry business at Flint, Mich. Six years later the business was transferred to Saginaw, and the present firm name was adopted in 1864, when Mr. Wood retired. The firm did an extensive business, especially in the equipment of lumber mills.

One of our contributors, in a private letter, writes: "I knew a mechanic at one time who used to amalgamate proverbs, and among other things used to say, 'A rolling stone is God's best work, and an honest man gathers no moss.'"

Inquiry for Machinery.

(145) Names and addresses of manufacturers, German or otherwise, of machines for cheaply cutting dies used for putting designs on buttons.

The highest chimney in the world is that of the Royal Saxon Smelting Works, at Halsbrucke, in Frieberg. The erection of the chimney was made necessary by the poisonous character of the fumes to be conveyed away. The gases before reaching the chimney are conveyed through a flue which passes over a bridge and is 1,640 feet long. This leads to a hill on which the chimney is placed, and its actual hight is 429 feet 6 inches, with an internal diameter at the top of 8 feet.

The Acme Machine Screw Company, of Hartford, Conn., has been awarded the John Scott Legacy Premium and Medal by the Franklin Institute on account of its multiple spindle automatic screw machine, illustrated and described in our issue No. 3, 1900.

"The Commercialist" is the title of a new publication from Scranton, Pa. It is issued by the Colliery Engineer Company, the proprietor of the International Correspondence Schools.

The publication office of "The Foundry" has been removed from Detroit to 1064 Rose Building, Cleveland, Ohio.

New Catalogs.

Wyman & Gordon, Worcester, Mass., have published a short description of the Marconi wireless telegraph, to which is added a brief catalog of forgings for crank shafts. Size, 4¼x7 inches.

The Becker-Brainard Milling Machine Company, Hyde Park, Mass., has published a pamphlet illustrating and describing its No. 5B plain horizontal milling machine. Size of pamphlet, standard, 6x9 inches.

The Henning Pocket Recorder for stress-strain diagrams of tests of materials, a pamphlet describing which was noticed in this department of our No. 6, is for sale by Gus. C. Henning, 220 Broadway, New York.

The American Blower Company, Detroit, Mich., has sent us illustrated sectional catalog No. 118 describing the "A B C" system of mechanical draft, forced and induced, by blowers and exhaust fans. It is 7⅜x8¾ inches.

The Grant-Ferris Company, Troy, N. Y., sends a catalog describing its hydro-carbon motors—the "Howard"—applicable to marine and stationary purposes, automobiles and agricultural implements. Size of pamphlet, 4x9 inches.

The Elwood City (Pa.) Gas Engine Company, publishes a catalog in which is illustrated and described its system of gas and gasoline engines for lighting, pumping, printing, marine machine shops and general purposes. Size, 8x5 inches.

The Stover Engine Works, Freeport, Ill., has for distribution a catalog of its gas and gasoline engines for general, agricultural and pumping purposes. Portable engines, on trucks entirely of steel, are among them. The pamphlet is 6x5½ inches.

The International Correspondence Schools, Scranton, Pa., send us a pamphlet relating to their school of sheet metal work, embracing courses for tinsmiths, coppersmiths, sheet-iron workers, plumbers, furnace-workers and architectural sheet-metal workers. It is 5¾x8¾ inches in size.

The Loomis Automobile Company, Westfield, Mass., has issued a small pamphlet in which is described its system of exhaust mufflers for deadening the noise of the exhaust from hydrocarbon motors. These mufflers are made of aluminum and asbestos. Size of catalog, 4¾x3½ inches.

The Lunkenheimer Company, Cincinnati, O., sends us a pamphlet upon its "'99 Model" standard injector, for high pressures and severe service. There are given copious directions for attaching and working, a sectional view with a numbered list of parts and a table of prices and capacities. Size of catalog, standard, 9x6 inches.

The Buffalo Forge Company, Buffalo, N. Y., sends us four little pamphlets relating respectively to its mechanical forced-draft system, mechanical induced draft, down-draft forges and its engines, as made in several horizontal and vertical patterns. Each pamphlet is 3½x6½ inches.

The C. W. Hunt Company, West New Brighton, Staten Island, N. Y., has sent a catalog, No. 0014, briefly describing its line of coal-handling machinery. Here are included automatic railways, storage buildings, parabolic boom towers, hoisting engines, weighing scales, etc. Size, 6¾x5½ inches.

The Hyatt Roller Bearing Company, Harrison, N. J., has published a catalog of power-transmission machinery embodying its flexible roller bearing. A varied line of hangers, pillow blocks, friction clutches, shafting, pulleys and other apparatus is here listed and priced. The pamphlet contains a telegraphic code. Size, 5x7⅝ inches.

The American Steel & Wire Company (Chicago office, Rookery Building) sends us a pamphlet list of its products, which are of great variety, from raw materials, such as ore, coal and coke, up through pig iron, billets, etc., to plates, sheets, shapes, shafting, steel and copper wire, wire rope, nails, springs, wire drawing dies, etc., etc. Size, 3⅜x6¼ inches.

The Sawyer Tool Company, Fitchburg, Mass., has published Catalog D, an illustrated price list of fine tools and hardware specialties which they manufacture. Among these are various sorts of rules, gages, squares, calipers and micrometers; protractors, bevels, straight-edges, trammels, tap wrenches, hammers, hack-saws, etc. Calipers and dividers of the J. Stevens Arms & Tool Company are included in the catalog. Size, 3⅞x5¾ inches.

The Geometric Drill Company, Westville, Conn., has sent us a pamphlet showing their screw-cutting die head, self-opening and self-adjustable, made in several styles, as well as their adjustable hollow milling tools for use on automatic screw machines, hand turret lathes, or for rotating, their adjustable collapsing tap and their bicycle spoke threading machine. It gives detailed descriptions and prices. Size, 6x9½ inches.

The W. P. Davis Machine Company, Rochester, N. Y., has ready for distribution to parties interested in machine tools its 1901 illustrated catalog of lathes, drills, keyseaters, cutting-off machines and special machinery. The lathes shown range from a 10-inch foot-power up to a 32-inch engine lathe; the cutting-off machines are from 3 to 6 inches; the keyseaters in two sizes and the upright drills from 12 to 32 inches swing. Size, standard, 6x9 inches.